Fall 2012

(Re)Creating the WorldGame: An Architectural Exploration of Risk

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13 December 2012

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ABSTRACT

Architecture, from its conception, has always played the role of shelter from the environment. While various techniques to mediate between the built and the natural world have been tested and implemented over the years, many of these practices have proven inadequate to completely shield the built world from a full range of hazards. How can architecture become more responsible in managing risk, especially when dealing with a myriad of risks globally? One possible solution is testing buildings and their components more thoroughly to better adapt to various environments. A building testing facility for the United Nations could benefit the world's population by allowing it to test its structures on a country by country basis in order to aid the nations most at threat, while locating the project in a statistically low risk country in order to protect these abilities.

Buckminster Fuller was also concerned in mediating risks globally. His WorldGame acted to solve the problems of the world through a comprehensive, anticipatory, science-based, design strategy to benefit mankind. "The WorldGame that Fuller envisaged was to be a place where individuals or teams of people came together and competed, or cooperated, to: 'make the world work, for 100% of humanity, in the shortest possible time, through spontaneous cooperation, without ecological offense, or the disadvantage of anyone.'[1] In order to have this kind of power, the game needed to have the kind of information and tools for manipulating that kind of information that empowers. The game needed an inventory of the world's vital statistics- where everything was and in what quantities and qualities, from minerals, to manufactured goods and services, to humans and their unmet needs as well as capabilities. The game also needed an information source that would monitor the current state of the world, bringing vital news into the 'game room' live. None of this existed when Fuller began talking about the game.[2] With modern technology and the invention of the internet, Fuller's model is ripe for reevaluation in mediating risk for today's world. Using the World Game as a lens for viewing the project, we can start to understand how buildings and the environment interact to facilitate or block risk and how these methods could be implemented to eliminate risk in structures for the future.

In using Fuller's WorldGame as a lens for which to view the project, the first step was to form a database reflective of today's world. In order to create the database, all risk factors that affect or are affected by the built environment were considered for analysis. Using global organizations like the United Nations and its affiliated branches, maps for the most recent years were collected and then represented graphically in a consistent manner in order to form comparisons. This was done in order to understand how risk and architecture interact and how architecture could act more responsively in order to mediate these risks in the future. This, in essence, became the game aspect of the project, helping to locate both a program and a site through playing out the WorldGame.

The top ten most frequent countries in both the very high and very low quantiles were then examined in order to determine the most suitable location for a site. Because the project is conceived as an aid to help the segment of the world's population facing the highest risk, deciding on a single site was difficult. If the project were to be located in a country with very high risk associated with it, it would be hard to create a feasible project. If, for example, the project were to be located in Afghanistan, the most frequently high risk country, many of its political issues would interfere with helping the rest of the world population. In the end, it was decided that the building testing facility should be placed in a country with very low risk associated with it in order to protect the building, but that it would still work to benefit those in very high risk countries.

In order to understand the possible equipment to be used in the building testing facility, information on the machinery was gathered and modeled. Structural engineering, wind tunnel, electromagnetic, fire resistance, chemical substance control, centrifuge, biological clean room, horticulture, insect control, earthquake, solar, extreme temperature, tsunami and flooding, and missile impact testing facilities were all examined in order to understand their requirements. In the WorldGame, these machines and facilities act as the board game, creating the base for players to interact with. In the end, these machines will combine to create the ultimate in interaction through the creation of a game stadium where all game pieces can be tested at once.

Case studies were examined through a matrix in order to understand architecture's capacity in handling risk. Throughout a project's lifespan, its ability to handle risk can vary from stage to stage. In order to understand how buildings operate in terms of risk, case studies were chosen that address risk on a global scale and were compared through their construction, exterior environment, interior environment, assembly practices, and programmatic use. The lessons learned from these case studies will be used in designing the building testing facility to ensure that each testing lab either blocks or bypasses risks rather than producing or ignoring them. The building itself will also have to adhere to these standards for the given site once it is chosen.

With all the pieces of the game in order, the final step of actually implementing the game will be carried out through design. The ultimate goal of the project is to create a "game stadium" where all the risk factors and building methods can be tested one by one or all at once on real buildings and building components. A stadium of this nature will allow the United Nations to test its structures on a country by country basis in order to aid the nations most at threat before a risk becomes realized, while still keeping the facility itself safe from harm. In this way, the project will live up to Fuller's own approach of being comprehensive, anticipatory, a design strategy, and a science-based methodology that works to benefit all of humanity.

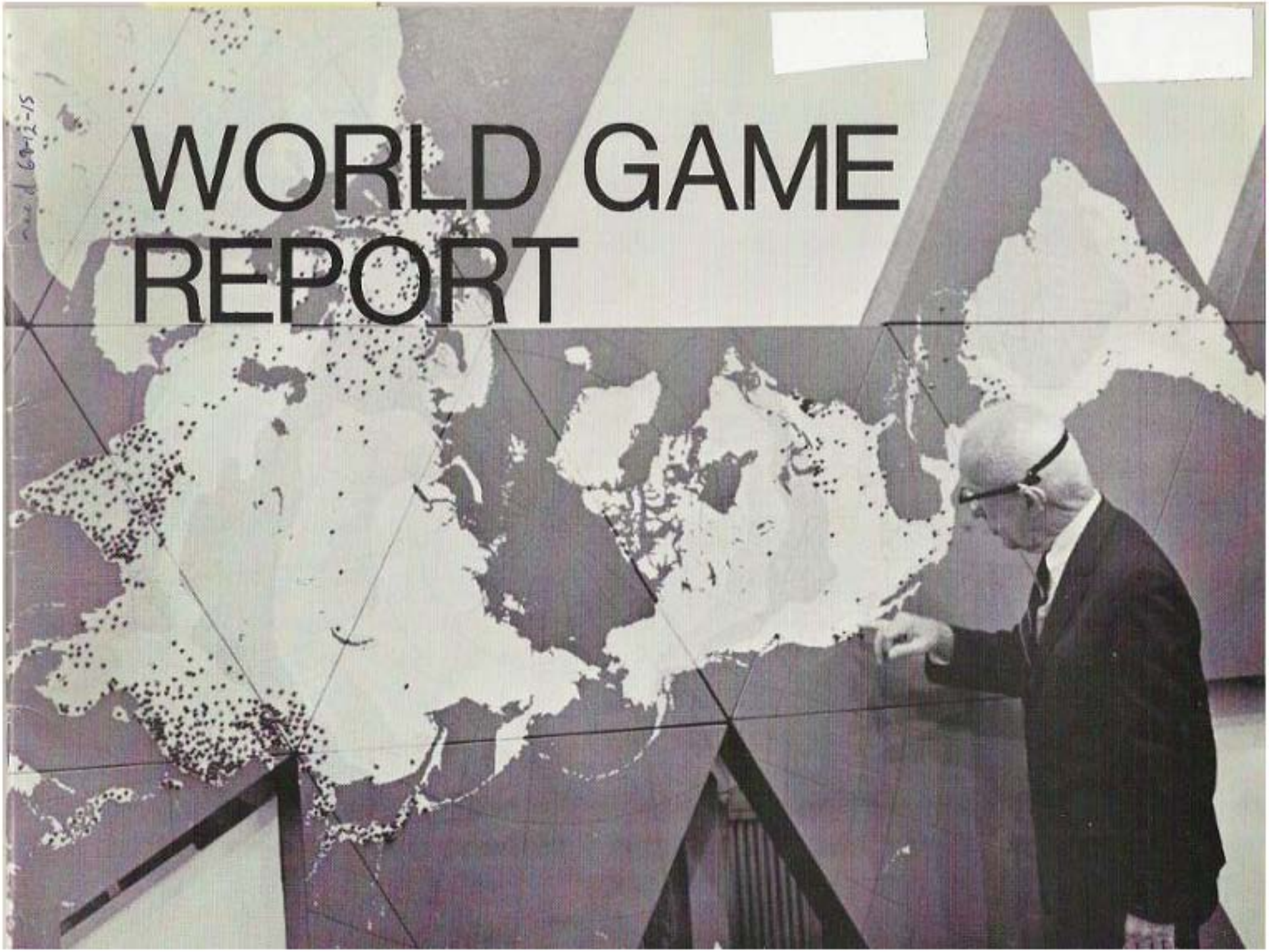
[1]Gabel, Medard."Buckminster Fuller and the Game of the World," in Buckminster Fuller: Anthology for the new Millenium, ed. Thomas T. K. Zung. New York: St. Martin's Press 2001, 123-124.

[2]Ibid., 125

Image Credit:

Keyes, Gene. "Evolution of the Dymaxion Map: An Illustrated Tour and Critique: Part 6." Last Modified June 15, 2009. http://www.genekeyes.com/FULLER/BF-6-later-ed.html.

WORLD GAME REPORT



CONTEXT: BUCKMINSTER FULLER

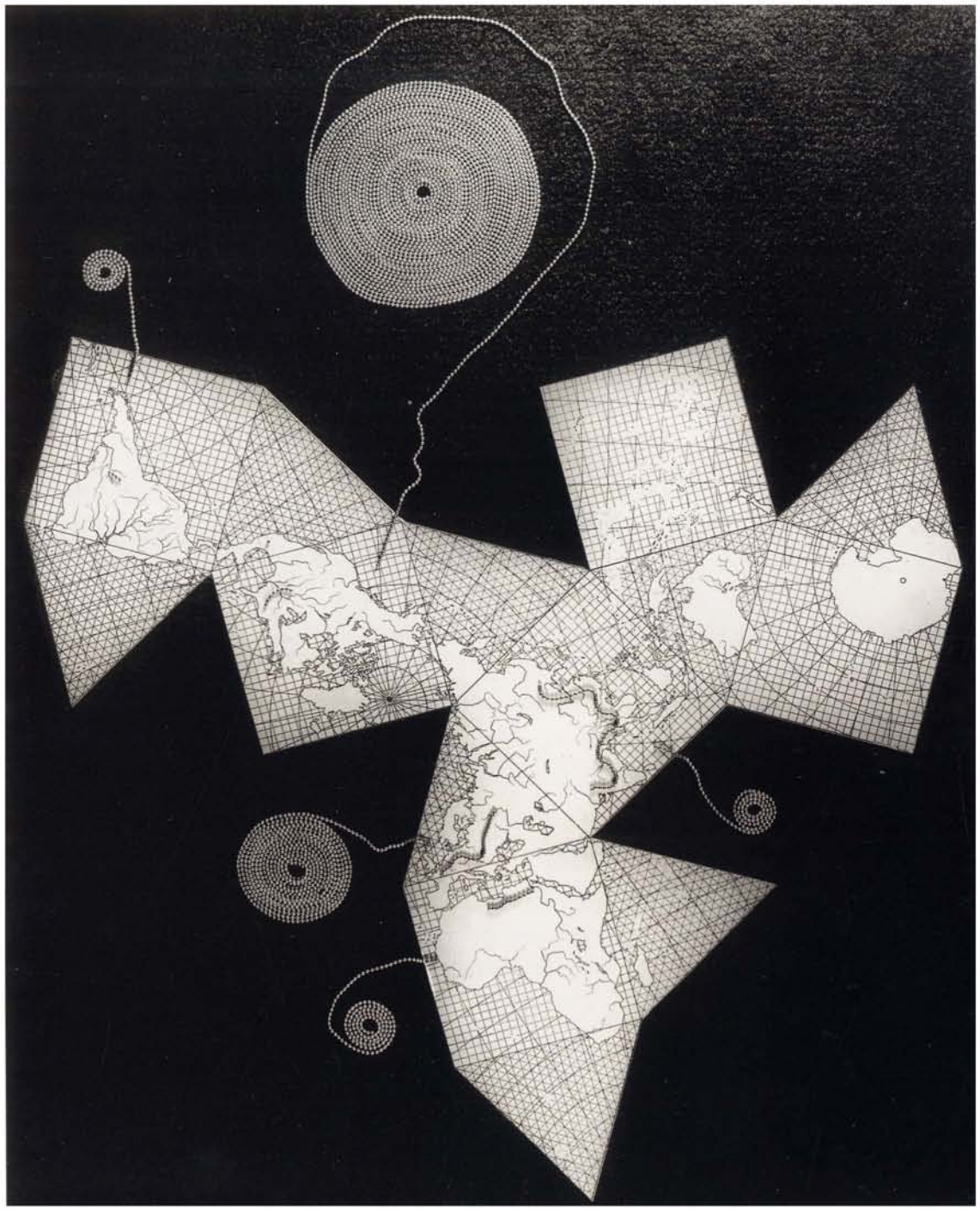
"His approach as he would later codify it was:

-**comprehensive**, starting from the whole system and working back to the special case, dealing with all facets of a problem, including the larger system the problem was part of

-**anticipatory**, in that it sought to recognize the threats coming down the pike before they arrived full-blown on an unsuspecting or ill-prepared society, as well as to deal with the way things were going to be when the solution was going to be implemented, not the way things were in the present.

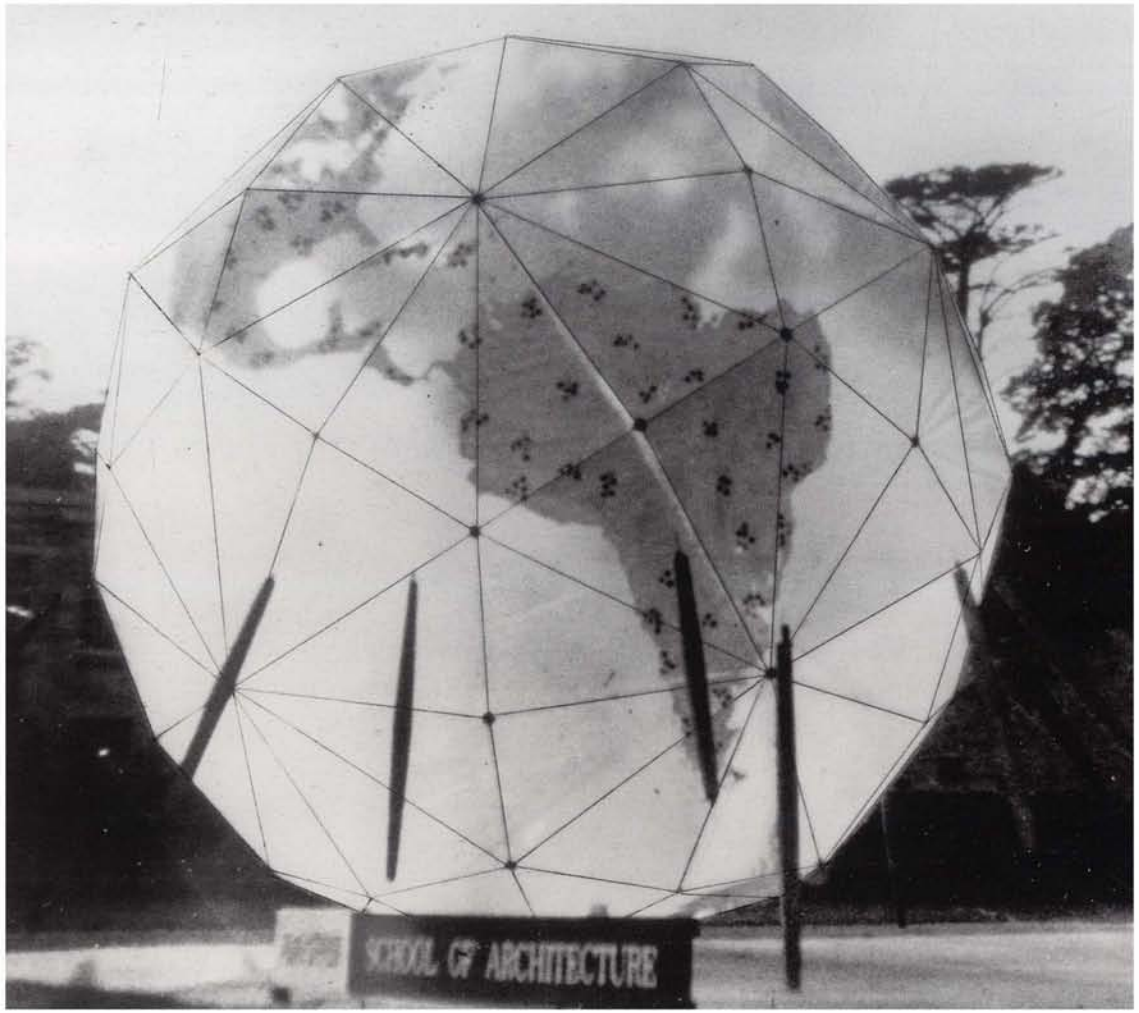
-**a design strategy**, in contradiction to a political, or let's-pass-a-law-and-change-human-behavior, approach that sought to change the larger system of which the specific problem was part of

-**a science-based methodology** that used the latest advances of science to benefit humanity"



CONTEXT: BUCKMINSTER FULLER

"World Game was intended to be a tool that would facilitate a comprehensive, anticipatory design science approach to the problems of the world. The use of 'world' in the title obviously reflects Fuller's global perspective and his contention that we now need a systems approach that deals with the world as a whole, and not a piece meal approach that tackles our problems in what he called a 'local focus hocus pocus' manner. **The entire world is now the relevant unit of analysis, not the city, state, or nation.** We are, in Fuller's words, aboard Spaceship Earth, and the illogic of two hundred nation state admirals all trying to steer the spaceship in different directions is made clear through the metaphor as well as in Fuller's more caustic assessment of nation-states as 'blood clots' in the world's global metabolism.[3]"



Text and images from:

[3]Gabel, Medard."Buckminster Fuller and the Game of the World," in Buckminster Fuller: Anthology for the new Millenium, ed. Thomas T. K. Zung. New York: St. Martin's Press 2001, 123-124.

WORLDGAME

"Obviously intending it as a very serious tool, Fuller choose to call his vision a 'game' because he wanted it to be seen as something that was accessible to everyone, not just the elite few in the power structure who thought they were running the show. In this sense, it was one of Fuller's more profoundly subversive visions. Fuller wanted a tool that would be accessible to everyone., whose findings would be widely disseminated to the masses through a free press, and that would, through this groundswell of public vetting and acceptance of solutions to society's problems, ultimately force the political process to move in the direction that the values, imagination, and problem-solving skills of those playing the democratically open World Game dictated. **The World Game that Fuller envisaged was to be a place where individuals or teams of people came together and competed, or cooperated, to: 'make the world work, for 100% of humanity, in the shortest possible time, through spontaneous cooperation, without ecological offense, or the disadvantage of anyone.[4]"**

[4]Gabel, Medard."Buckminster Fuller and the Game of the World," in Buckminster Fuller: Anthology for the new Millenium, ed. Thomas T. K. Zung. New York: St. Martin's Press 2001, 125.

"**In order to have this kind of power, the game needed to have the kind of information and tools for manipulating that kind of information that empowers**. It needed a comprehensive database that would provide the players of the World Game with better data than their politically elected or appointed counterparts had. They needed an inventory of the world's vital statistics- where everything was and in what quantities and qualities, from minerals, to manufactured goods and services, to humans and their unmet needs as well as capabilities. They also needed an information source that would monitor the current state of the world, bringing vital news into the 'game room' live. **None of this existed when Fuller began talking about the game**. And then something funny happened on the way to the twenty-first century: CNN, personal computers, CD-ROMS, the internet and the World Wide Web, super computer power on personal computers. Reams of data about the world, its resources, its problems, and potential solutions started to bubble to the surface and transform the world and the way we communicate, do business, research, and govern.[5]"

[5]Gabel, Medard."Buckminster Fuller and the Game of the World," in Buckminster Fuller: Anthology for the new Millenium, ed. Thomas T. K. Zung. New York: St. Martin's Press 2001, 125.

(RE)CREATING THE WORLDGAME

While Fuller's model had high ambitions, it failed to reach its full potential. The Game was meant to be a participatory tool, but it was unable to retain this property in its materialization. **The game, while successful in creating solutions to various risk factors through social cooperation, never breached into the field of architecture itself to address risks at their source.** Fuller's model is ripe for reevaluation in mediating risk for today's world, especially with the aid of modern technology and data collecting methods. It is important to understand how buildings and the environment interact to facilitate or block risk and how these methods could be implemented in structures in the future to eliminate threats before they become an issue.

FIGURE 1:

Author made image of Fuller's Dymaxion map

THE PAWNS

In order to create the database, **all risk factors that affect or are affected by the built environment were considered for analysis**. Using global organizations like the United Nations and its affiliated branches, maps for the most recent years were collected and then represented graphically in a consistent manner in order to form comparisons. This was done in order to understand how risk and architecture interact and how architecture could act more responsively in order to mediate these risks in the future. This, in essence, became the game aspect of the project, helping to locate both a program and a site through playing out the WorldGame.

FIGURE 2:

Author made image of Fuller's Dymaxion map


RISK LEVEL BY COUNTRY
VERY LOW
LOW
MEDIUM
HIGH
VERY HIGH

1. ECOLOGICAL FOOTPRINT:

"IMPACT ON THE ENVIRONMENT; THE SHAPE AND SIZE OF THE AREA SOMETHING OCCUPIES[6]"

This map is based on the Global Footprint Network's Ecological Footprint Map. The Ecological Footprint measures how fast we consume resources and generate wastes vs how fast nature can absorb our waste and generate new resources. The higher the footprint, the more resources are being used that cannot be replaced.[7]

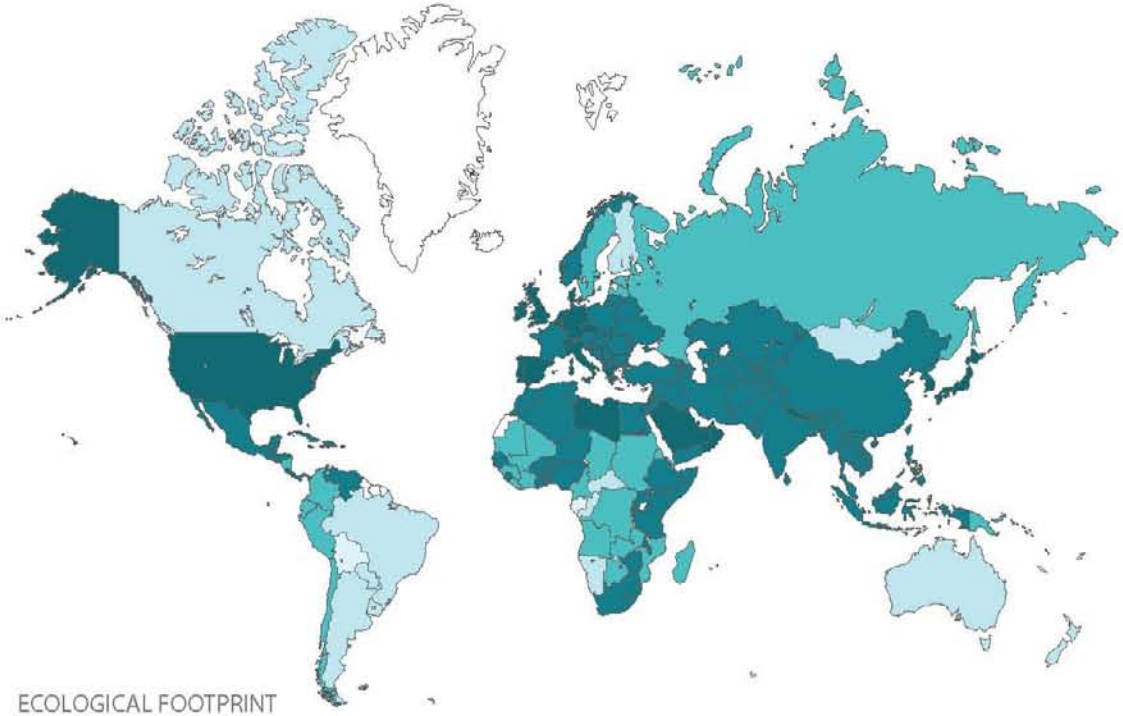
[6]DICTIONARY.COM. "Footprint". Accessed October 24, 2012. http://dictionary.reference.com/browse/footprint?s=t

2. FOSSIL FUEL DEPENDENCY:

"RELYING ON SOMEONE OR SOMETHING ELSE FOR AID, SUPPORT, ETC; SUBORDINATE; SUBJECT[8]"

This map is based on the GeoCurrent's Fossil Fuel Dependency Map. Currently, oil (4059.1 million tonnes) has the highest global energy use, followed by coal (3724.3 million tonnes), natural gas (2905.6 million tonnes), hydroelectricity (791.5 million tonnes), nuclear energy (599.3 million tonnes), and other renewable sources (194.8 million tonnes).[9]

[8]DICTIONARY.COM. "Dependency". Accessed October 24, 2012. http://dictionary.reference.com/browse/dependent?s=t

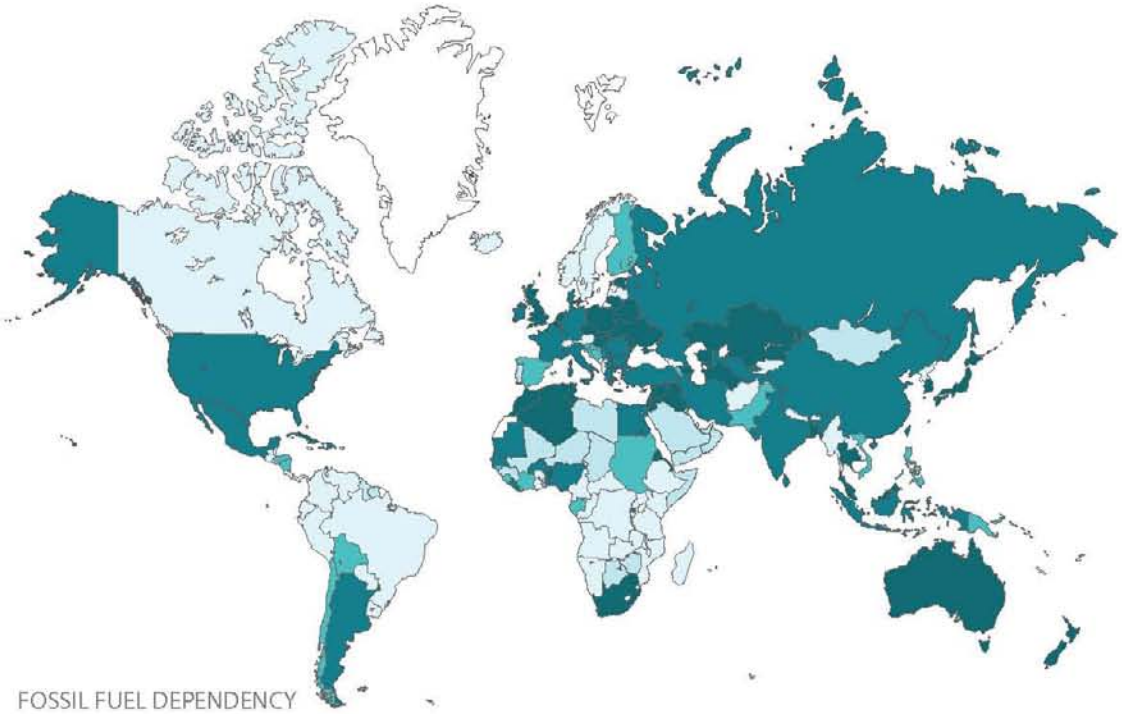


ECOLOGICAL FOOTPRINT

FIGURE 3:
The Global Footprint Risk Index ranks countries on their consumption vs their biocapacity. This map helps to identify areas which face the highest risk of consumption to identify hotspots.

Adapted by author from:

[7]GLOBAL FOOTPRINT NETWORK. "Ecological Footprint of Consumption Compared to Biocapacity." Accessed September 29, 2012.



FOSSIL FUEL DEPENDENCY

FIGURE 4:
The Fossil Fuel Dependency Index ranks countries on their consumption of renewable vs nonrenewable sources. This map helps to identify areas which face the highest risk of dependency to identify hotspots.

Adapted by author from:

[9]GEOCURRENTS. "Mapping Renewable Electricity Generation." Accessed September 29, 2012. http://geocurrents.info/geonotes/mapping-renewable-electricity-generation

3. EXTREME WEATHER:

"AN EVENT THAT IS RARE WITHIN ITS STATISTICAL REFERENCE DISTRIBUTION AT A PARTICULAR PLACE IN SCALE OR MAGNITUDE[10]"

This map is based on the Center for Global Development's Extreme Weather Map for 2011. Extreme Weather can occur in any natural hazard event. From most common to least common, floods (30.7%), windstorms (26.8%), earthquakes (8.9%), droughts (7.8%), landslides (5.1%), extreme temperatures (3.5%), wildfires (3.4%), volcanoes (1.7%), and other similar events can become extreme weather events.[11]

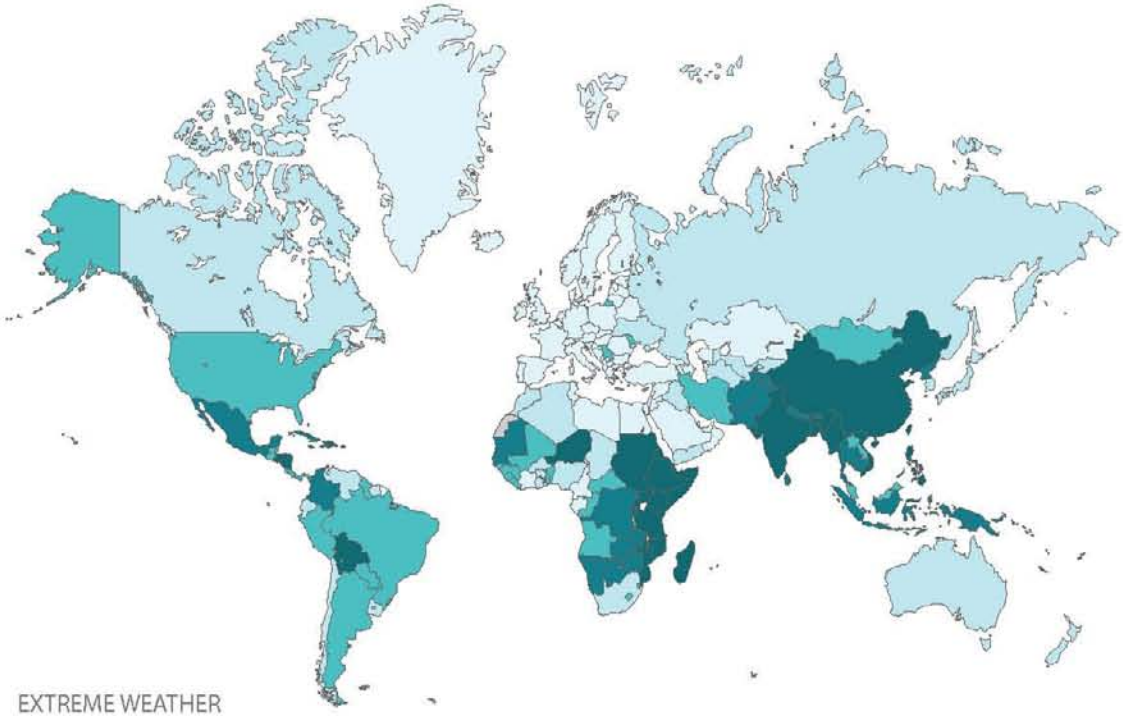
[10]DICTIONARY.COM. "Extreme Weather". Accessed October 24, 2012. http://dictionary.reference.com/browse/weather?fromAsk=true&o=100074

4. ENDANGERED SPECIES:

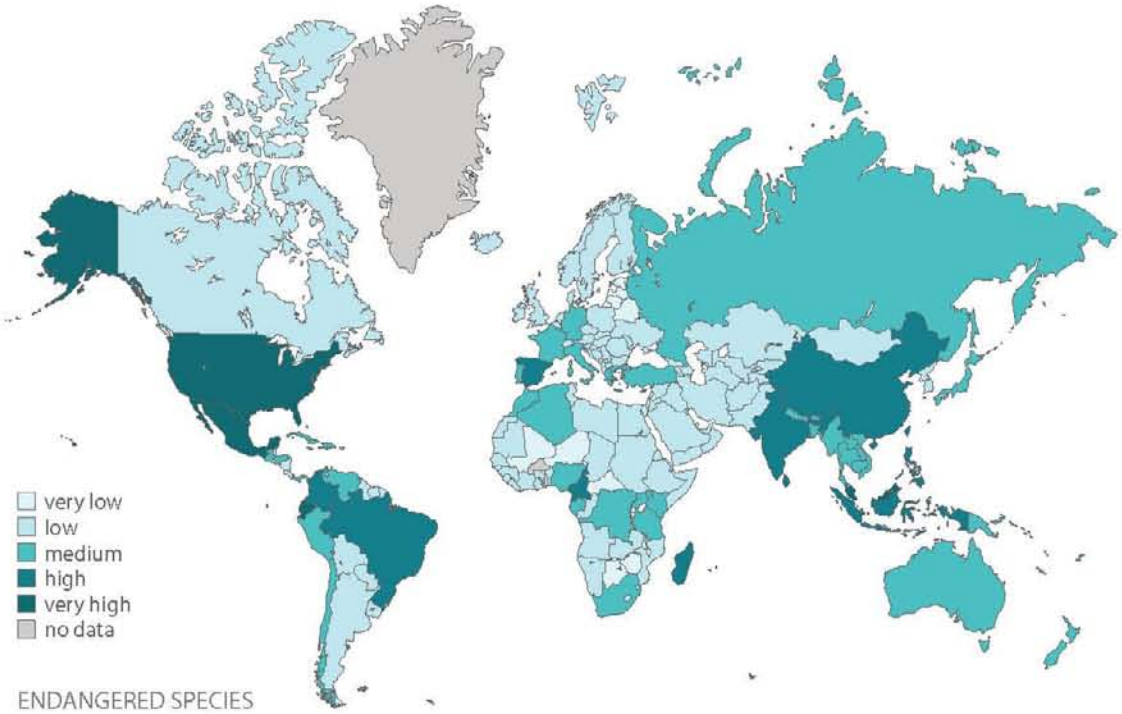
"A SPECIES AT RISK OF EXTINCTION BECAUSE OF HUMAN ACTIVITY, CHANGES IN CLIMATE, CHANGES IN PREDATOR-PREY RATIOS, ETC[12]"

This map is based on the IUCN's Red List Endangered Species Map for 2012. It takes into account all globally recorded endangered species for those countries that have kept a record for as long as they have kept those records.[13]

[12]DICTIONARY.COM. "Endangered Species". Accessed October 24, 2012. http://dictionary.reference.com/browse/endangered+species?s=t&ld=1093



EXTREME WEATHER



ENDANGERED SPECIES

FIGURE 5:
The Extreme Weather Risk Index ranks countries on their risk to a variety of weather events. This map helps to identify areas which face the highest risk when weather events are averaged to identify hotspots.

Adapted by author from:

[11]CENTER FOR GLOBAL DEVELOPMENT. "Extreme Weather." Accessed October 15, 2012. http://www.cgdev.org/section/topics/climate_change/mapping_the_impacts_of_climate_change

FIGURE 6:
The Endangered Species Index ranks countries by the amount of endangered species they contain. This map helps to identify potential extinction hotspots.

Adapted by author from:

[12]THE GUARDIAN. "Where Species Went Extinct." Last modified September, 2012. http://www.guardian.co.uk/environment/interactive/2012/sep/03/extinct-and-endangered-species-interactive

5. NON-COMMUNICABLE DISEASE

"A MEDICAL CONDITION OR DISEASE WHICH BY DEFINITION IS NON-INFECTIOUS AND NON-TRANSMISSIBLE BETWEEN PERSONS[14]"

This map is based on the World Health Organization's Non-Communicable Disease Map for 2006. It asses risks that countries may experience based on the spread of infectious disease using data from the World Health Report 2006. It is comprises of three categories of risk: cardiovascular disease, respiratory disease, and diabetes.[15]

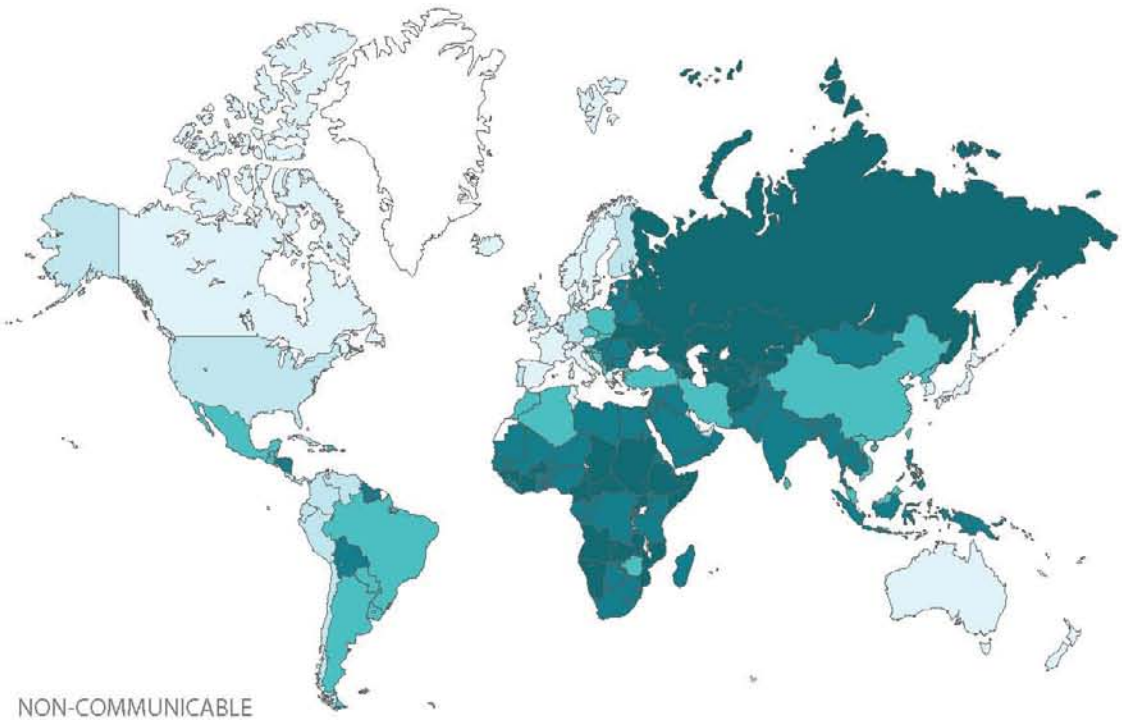
[14]DICTIONARY.COM. "Non-Communicable Disease". Accessed October 24, 2012. http://dictionary.reference.com/browse/non_communicable+disease?s=t&ld=1093

6. WATER SCARCITY

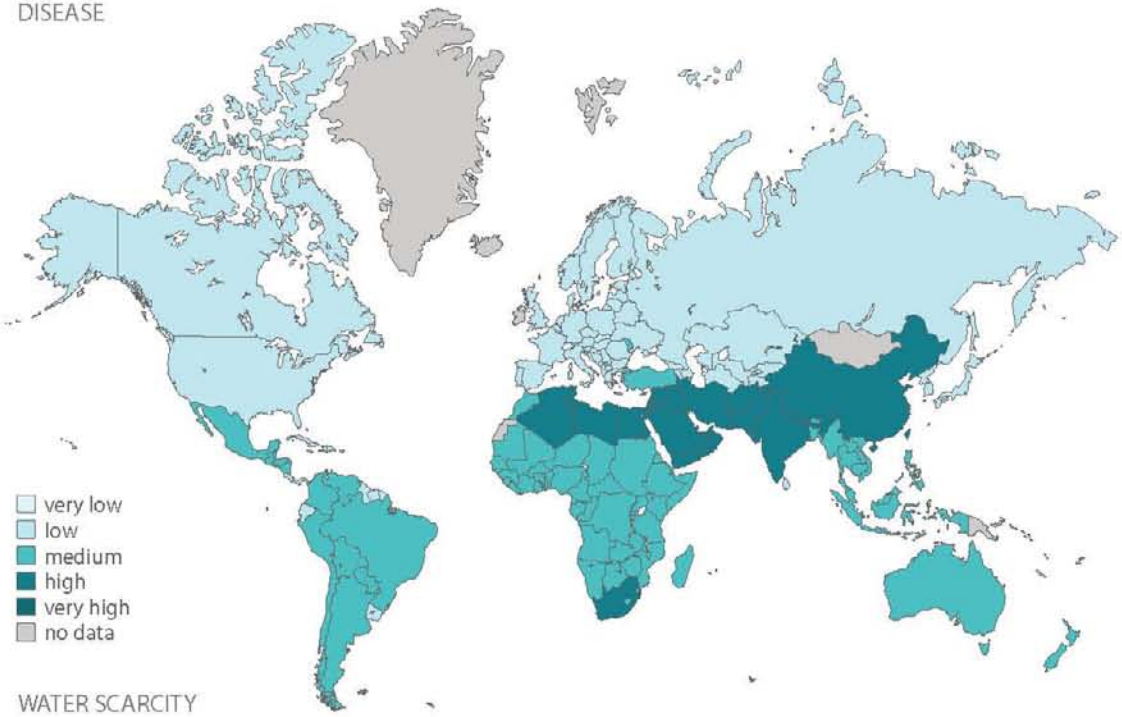
"INSUFFICIENCY OR SHORTNESS OF SUPPLY; SHORTAGE, WANT, LACK[16]"

This map is based on the Water Woe's Water Scarcity Map. Water scarcity is becoming increasingly more of an issue, especially as potable water is becoming harder to find. Salination, parasites, decreased ground water, climate change, and decreased rainfall all contribute to water scarcity.[17]

[16]DICTIONARY.COM. "Scarcity". Accessed October 24, 2012. http://dictionary.reference.com/browse/scarcity?fromAsk=true&o=100500



NON-COMMUNICABLE DISEASE



WATER SCARCITY

FIGURE 7:
The Non-Communicable Disease Index ranks countries by the amount of NCD deaths and the probability for future deaths. This map helps to identify potential high risk NCD hotspots.

Adapted by author from:

[18]WORLD HEALTH ORGANIZATION. "Probability of Dying from a Non-Communicable Disease." Accessed September 22, 2012. http://humanosphere.kplu.org/wp-content/uploads/2012/06/NCDmap.png

FIGURE 8:
The Water Scarcity Index ranks countries by their lack of potable drinking water. This map helps to identify potential scarcity hotspots.

Adapted by author from:

[17]WATER WOES. "Water Scarcity." Accessed September 22, 2012. http://whyfiles.org/131fresh_water/2.html

7. LACK OF COPING CAPABILITIES:

"TO FACE AND DEAL WITH RESPONSIBILITIES, PROBLEMS, OR DIFFICULTIES, ESPECIALLY SUCCESSFULLY OR IN A CALM OR ADEQUATE MANNER[18]"

This map is based on the WorldRiskReport for 2011. It assesses a country's overall risk year by year by assigning a score of 1 to 196 by examining data such as susceptibility, exposure, lack of coping capacities, vulnerability, lack of adaptive capabilities, and insecurity. Lack of coping capabilities is comprised of three categories of risk: government and authorities (corruption), medical services (number of physicians and hospital beds), material coverage (insurances).[19]

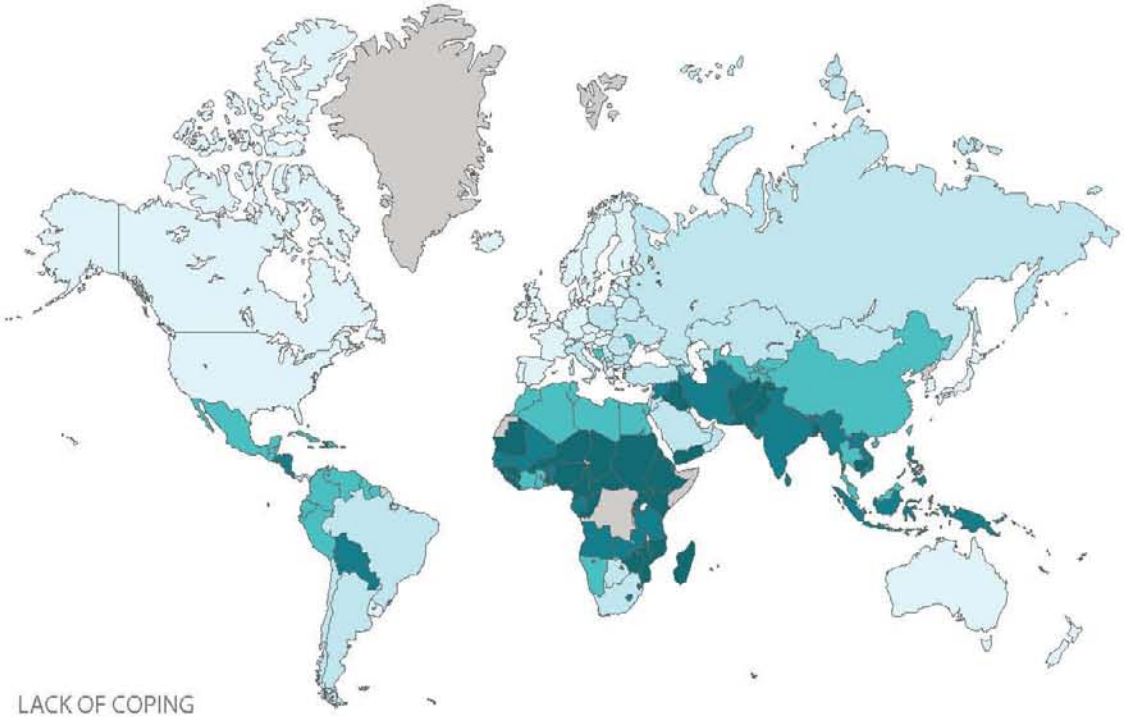
[18]DICTIONARY.COM. "Cope". Accessed October 24, 2012. http://dictionary.reference.com/browse/cope?s=t&ld=1093

8. LACK OF ADAPTATION:

"A FORM OR STRUCTURE MODIFIED TO FIT A CHANGED ENVIRONMENT; THE ABILITY OF A SPECIES TO SURVIVE BECAUSE OF ALTERATIONS OF FORM OR BEHAVIOR BROUGHT ABOUT THROUGH NATURAL SELECTION[20]"

This map is based on the WorldRiskReport for 2011. It assesses a country's overall risk year by year by assigning a score of 1 to 196 by examining data such as susceptibility, exposure, lack of coping capacities, vulnerability, lack of adaptive capabilities, and insecurity. Lack of adaptation is comprised of four categories of risk: education and research, gender equity, environmental status/ecosystem protection, and investment.[21]

[20]DICTIONARY.COM. "Adaptation". Accessed October 24, 2012. http://dictionary.reference.com/browse/adaptation?s=t&ld=1093

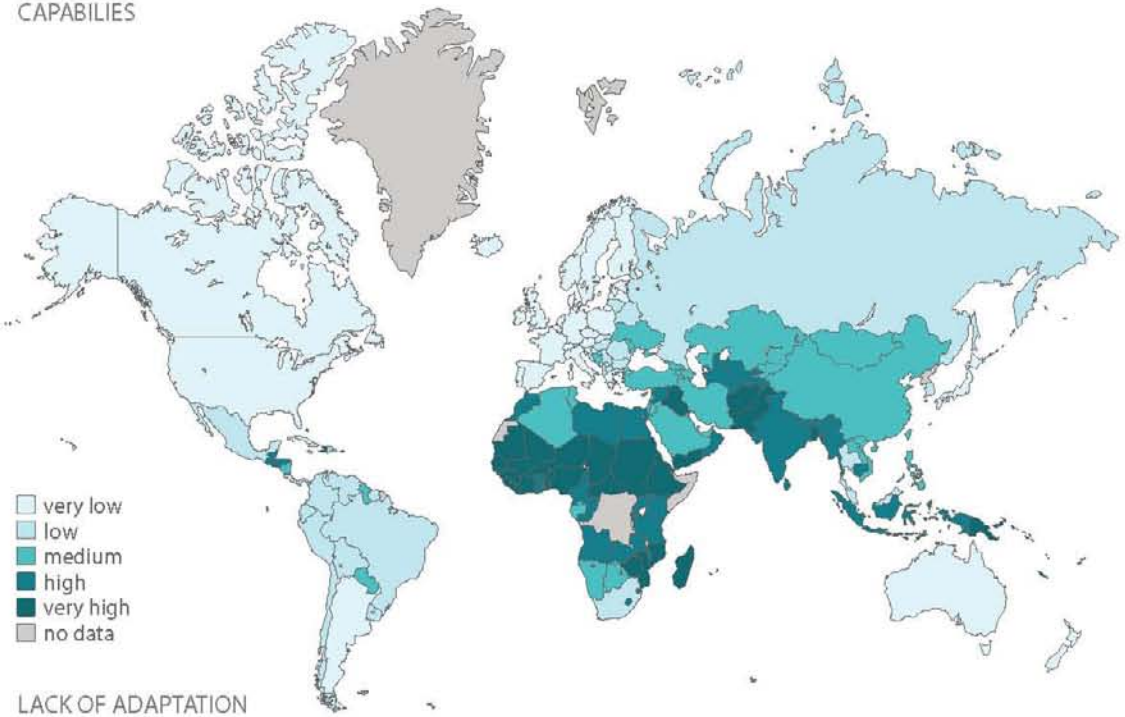


LACK OF COPING CAPABILITIES

FIGURE 9:
The Lack of Coping Capabilities Risk Index ranks countries to calculate the likelihood of how countries can cope to risk factors. This map helps to identify poor coping hotspots.

Adapted by author from:

[19]WORLD ECONOMIC FORUM. "World Risk Report 2011." Accessed September 24, 2012. http://www.ehs.unu.edu/file/get/9018



LACK OF ADAPTATION

FIGURE 10:
The Lack of Adaptation Risk Index ranks countries to calculate the liklihood of how poorly it can adapt to risk factors. This map helps to identify poor adaptive hotspots.

Adapted by author from:

[21]WORLD ECONOMIC FORUM. "World Risk Report 2011." Accessed September 24, 2012. http://www.ehs.unu.edu/file/get/9018

9. SUSCEPTIBILITY:

" LIABLE TO BE AFFLICTED; ACCESSIBLE OR ESPECIALLY LIABLE OR SUBJECT TO SOME INFLUENCE, MOOD, AGENCY, ETC[22]"

This map is based on the WorldRiskReport for 2011. It assesses a country's overall risk year by year by assigning a score of 1 to 196 by examining data such as susceptibility, exposure, lack of coping capacities, vulnerability, lack of adaptive capabilities, and insecurity. Susceptibility is comprised of four categories of risk: public infrastructure, nutrition, poverty and dependence, and economic capacity and income distribution.[23]

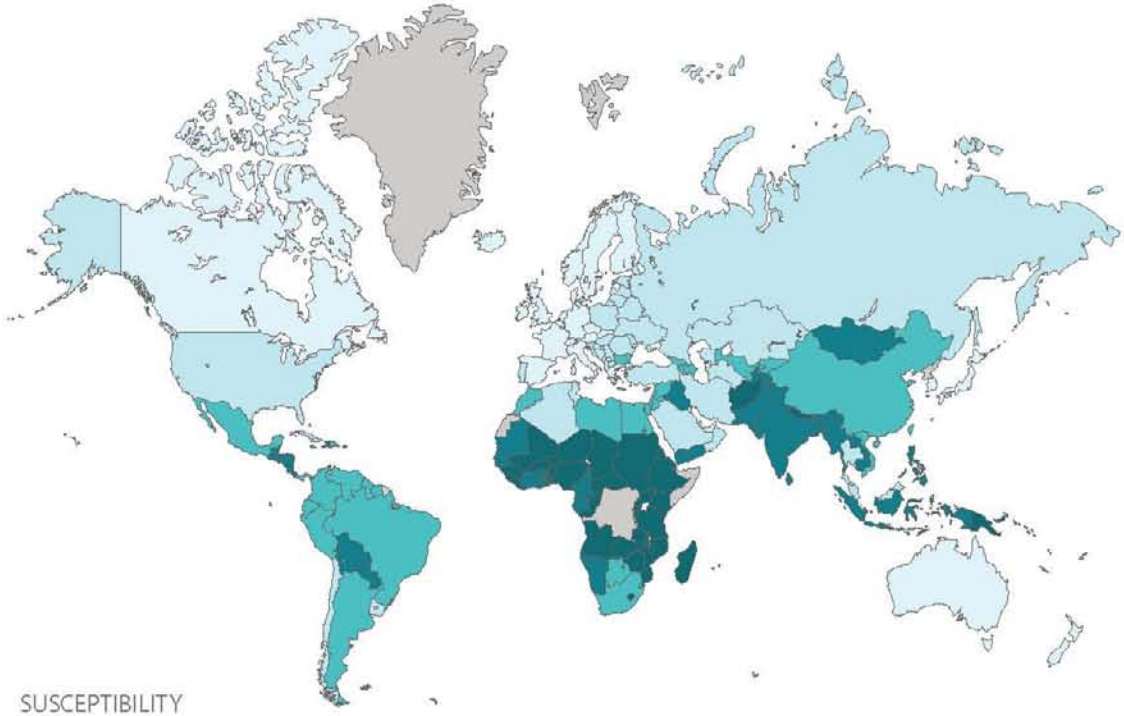
[22]DICTIONARY.COM. "Susceptibility". Accessed October 24, 2012. http://dictionary.reference.com/browse/susceptible?s=t&ld=1093

10. VULNERABILITY:

"CAPABLE OF BEING PHYSICALLY OR EMOTIONALLY WOUNDED OR HURT; LIABLE OR EXPOSED TO DISEASE, DISASTER, ETC, LIABLE OR EXPOSED TO ATTACK[24]"

This map is based on the WorldRiskReport for 2011. It assesses a country's overall risk year by year by assigning a score of 1 to 196 by examining data such as susceptibility, exposure, lack of coping capacities, vulnerability, lack of adaptive capabilities, and insecurity. Vulnerability is comprised of three categories of risk: likelihood of suffering harm, lack of capacities to reduce negative consequences during a disaster, and lack of capacities for long-term strategies for societal change.[25]

[24]DICTIONARY.COM. "Vulnerability". Accessed October 24, 2012. http://dictionary.reference.com/browse/vulnerability

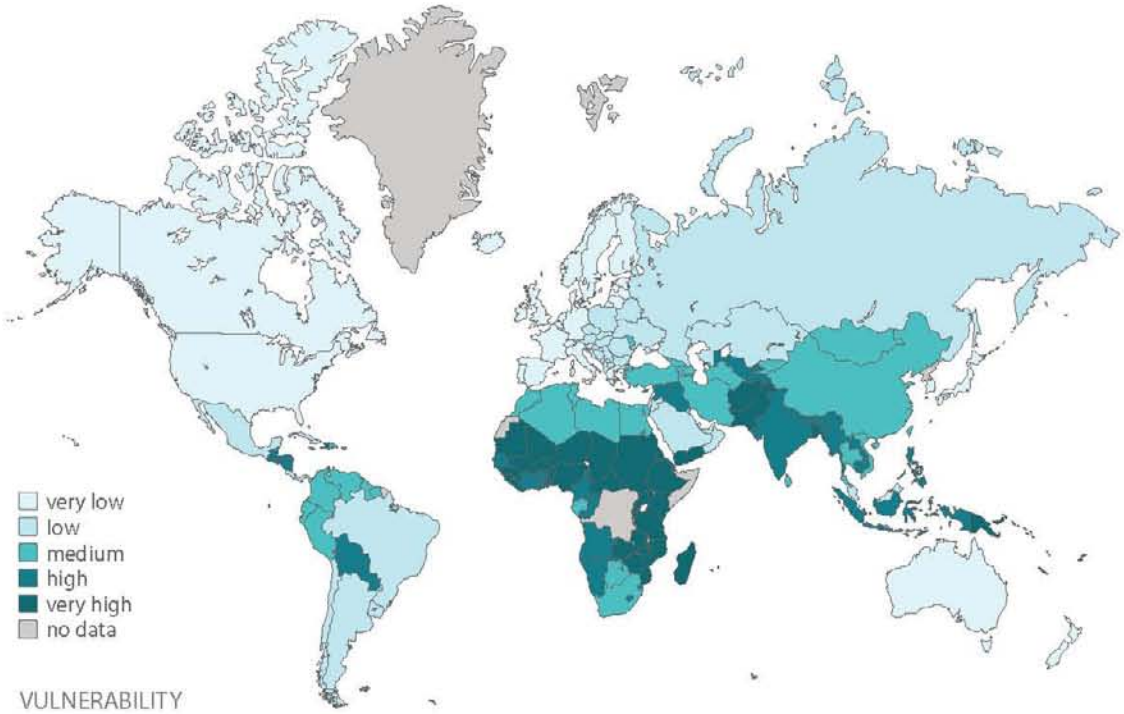


SUSCEPTIBILITY

FIGURE 11:
The Susceptibility Risk Index ranks countries to calculate the likelihood of how susceptible it is to risk factors. This map helps to identify susceptible hotspots.

Adapted by author from:

[23]WORLD ECONOMIC FORUM. "World Risk Report 2011." Accessed September 24, 2012. http://www.ehs.unu.edu/file/get/9018



VULNERABILITY

FIGURE 12:
The Vulnerability Risk Index ranks countries to calculate the likelihood of harm, and ability to handle those risks. This map helps to identify vulnerable hotspots.

Adapted by author from:

[25]WORLD ECONOMIC FORUM. "World Risk Report 2011." Accessed September 24, 2012. http://www.ehs.unu.edu/file/get/9018

11. COMMUNICABLE DISEASE:

"A DISEASE THAT IS TRANSMITTED THROUGH DIRECT CONTACT WITH AN INFECTED INDIVIDUAL OR INDIRECTLY THROUGH A VECTOR; ALSO CALLED CONTAGIOUS DISEASE[26]"

This map is based on Fondation Merieux's Infectious Disease Map for 2006. It asses risks that countries may experience based on the spread of infectious disease using data from the World Health Report 2006, World Bank, Institut Pasteur, and UNDP. It is comprised of three categories of risk: HIV/AIDS, Tuberculosis, and Malaria.[27]

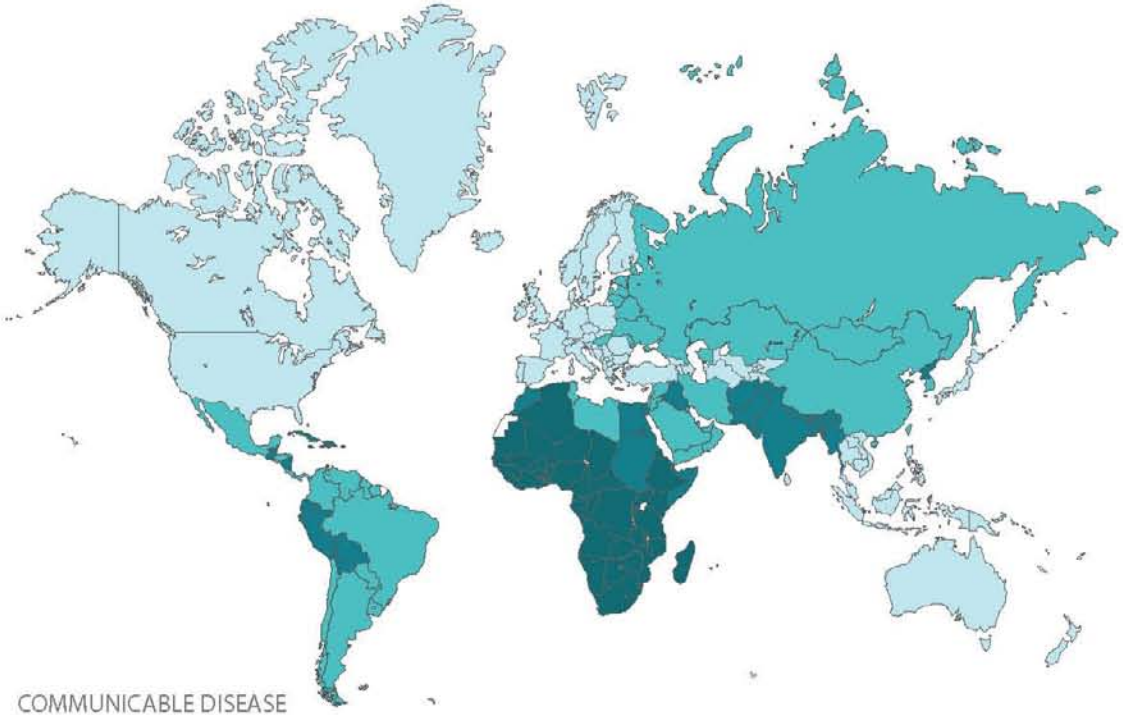
[26]DICTIONARY.COM. "Communicable Disease". Accessed October 24, 2012. http://dictionary.reference.com/browse/communicable+disease?s=t&ld=1093

12. TERRORISM:

"THE USE OF VIOLENCE AND THREATS TO INTIMIDATE OR COERCE, ESPECIALLY FOR POLITICAL PURPOSES[28]"

This map is based on Maplecroft's Political Risk Dynamic Index for 2012. It assesses risks that countries may experience based on direct government action, sub-state, or other politically motivated groups that would result in a rapid change within the country. It is comprised of five categories of risks: governance frame work, political violence, business and macroeconomics, forced regime change risk and resource nationalism.[29]

[28]DICTIONARY.COM. "Terrorism". Accessed October 24, 2012. http://dictionary.reference.com/browse/terrorism?s=t

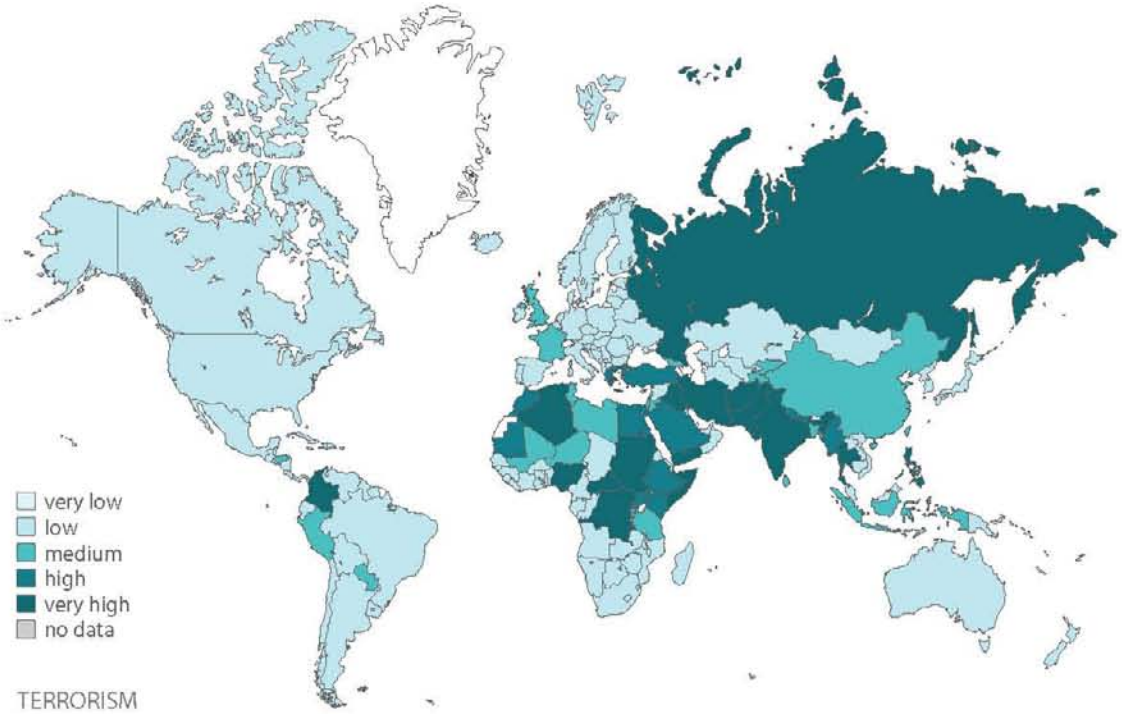


COMMUNICABLE DISEASE

FIGURE 13:
The Infectious Disease Index ranks countries based on deaths resulting from infectious and parasitic diseases per 10,000 inhabitants. This map helps to identify medical need hotspots.

Adapted by author from:

[27]FONDATION MERIEUX. "Infectious Diseases." Accessed September 29, 2012. http://www.fondation-merieux.org/infectious-diseases-map



TERRORISM

FIGURE 14:
The Terrorism Risk Index ranks 137 countries to calculate the frequency and lethality of terrorist incidents prior to April 1, 2011. This map helps to identify terrorist hotspots.

Adapted by author from:

[29]MAPLECROFT. "Political Risk Index." Accessed October 17, 2012. http://maplecroft.com/about/news/pra_2011.html.

13. FOOD DEPRIVATION:

"THE ABSENCE, LOSS, OR WITHHOLDING OF SOMETHING NEEDED[30]"

This map is based on the Food and Agriculture Organization of the United Nation's Food Deprivation Map. When a person has food deprivation, they consume less than 300 kCal daily, making daily functions hard to perform. This is especially dangerous when it is prevalent on a large scale.[31]

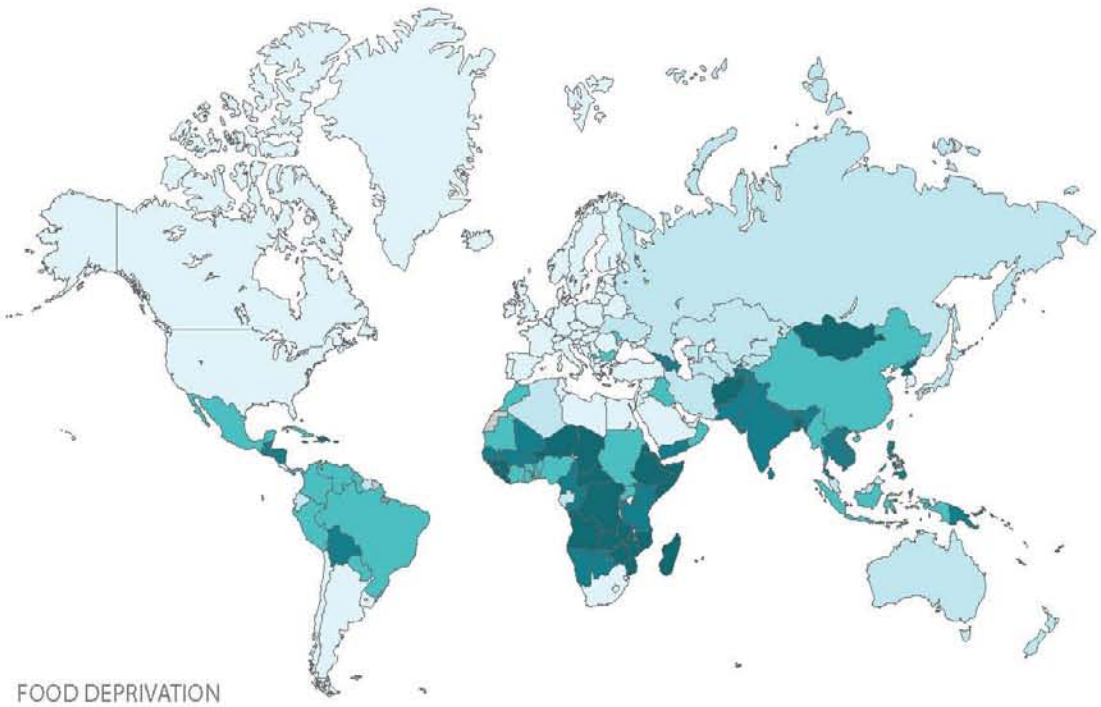
[30]DICTIONARY.COM. "Deprive". Accessed October 24, 2012. http://dictionary.reference.com/browse/deprivation?fromAsk=true&o=100074

14. AGRICULTURAL PRODUCTIVITY LOSS:

"LOSS IN THE QUALITY, STATE, OR FACT OF BEING ABLE TO GENERATE, CREATE, ENHANCE, OR BRING FORTH GOODS AND SERVICES[32]"

This map is based on the Center for Global Development's Agricultural Productivity Map for 2011. Agricultural Productivity is highly dependent on maintaining a consistent climate in which to grow crops, as well as pesticide, herbicide, and fertilizer performance.[33]

[32]DICTIONARY.COM. "Productivity". Accessed October 24, 2012. http://dictionary.reference.com/browse/productivity?s=t&ld=1093

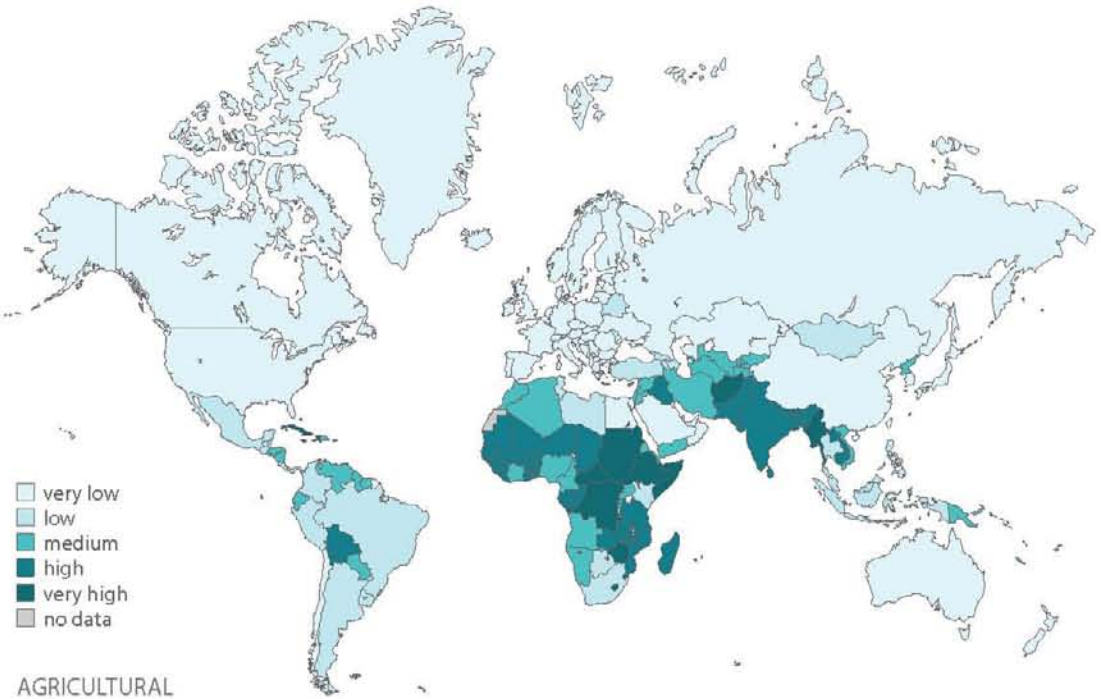


FOOD DEPRIVATION

FIGURE 15:
The Food Deprivation Index ranks countries on their risks of undernourishment. This map helps to determine food risk hotspots.

Adapted by author from:

[31]FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS: ANIMAL PRODUCTION AND HEALTH DIVISION. "Growth in Demand for Eggs 2000-2030." Last modified September, 2011. http://www.fao.org/docrep/x8200e/x8200e03.htm



AGRICULTURAL PRODUCTIVITY LOSS

FIGURE 16:
The Agricultural Productivity Index ranks countries on their risks of losing future crops. This map helps to future low producing hotspots.

Adapted by author from:

[33]CENTER FOR GLOBAL DEVELOPMENT. "Agricultural Productivity Loss." Accessed October 15, 2012. http://www.cgdev.org/section/topics/climate_change/mapping_the_impacts_of_climate_change

15. POLITICAL/ECONOMICAL:

"OF, PERTAINING TO, OR INVOLVING THE STATE OR ITS GOVERNMENT; EXERCISING OR SEEKING POWER IN THE GOVERNMENTAL OR PUBLIC AFFAIRS OF A STATE, MUNICIPALITY, ETC.[34]"

This map is based on AON's Political and Economic Risk Map for 2010. It is comprised of four categories of risks: government interference, legal and regulatory risks, currency, and credit risks.[35]

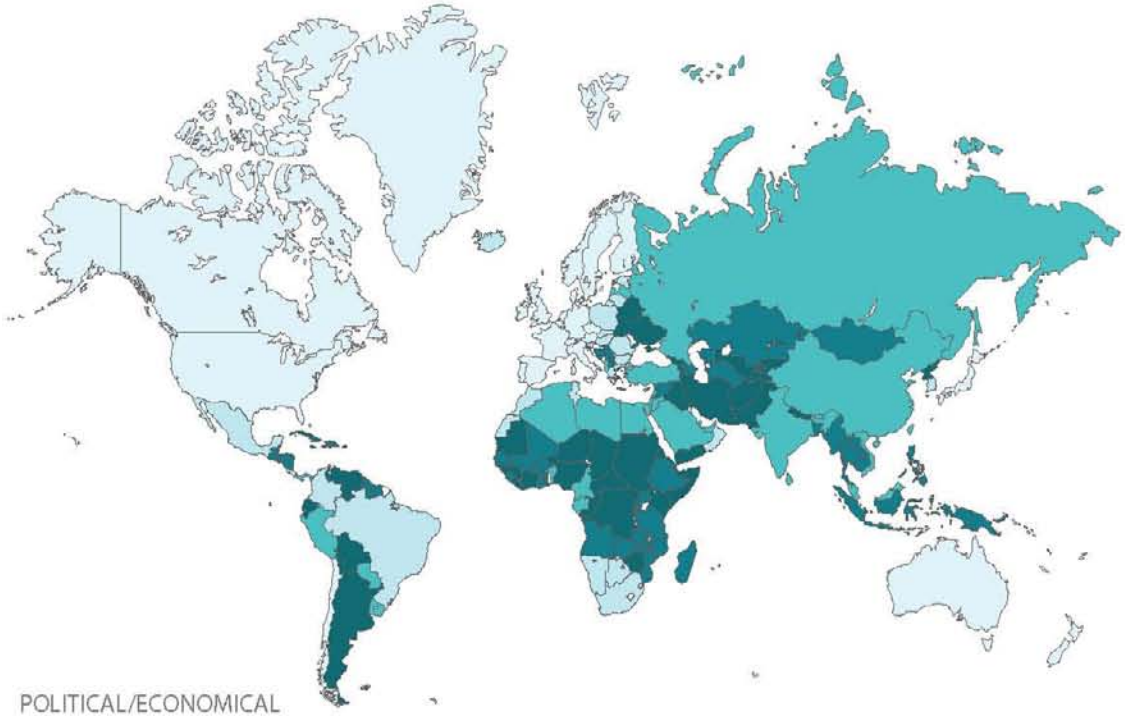
[34]DICTIONARY.COM. "Political". Accessed October 24, 2012. http://dictionary.reference.com/browse/political?s=t&ld=1093

16. INSECURITY:

"LACK OF CONFIDENCE OR ASSURANCE; NOT ADEQUATELY PROTECTED[36]"

This map is based on the WorldRiskReport for 2011. It assesses a country's overall risk year by year by assigning a score of 1 to 196 by examining data such as susceptibility, exposure, lack of coping capacities, vulnerability, lack of adaptive capabilities, and insecurity. Instability is comprised of three categories of risk: housing conditions, social networks, and disaster preparedness and early warning.[37]

[36]DICTIONARY.COM. "Insecurity". Accessed October 24, 2012. http://dictionary.reference.com/browse/insecurity?s=t&ld=1093

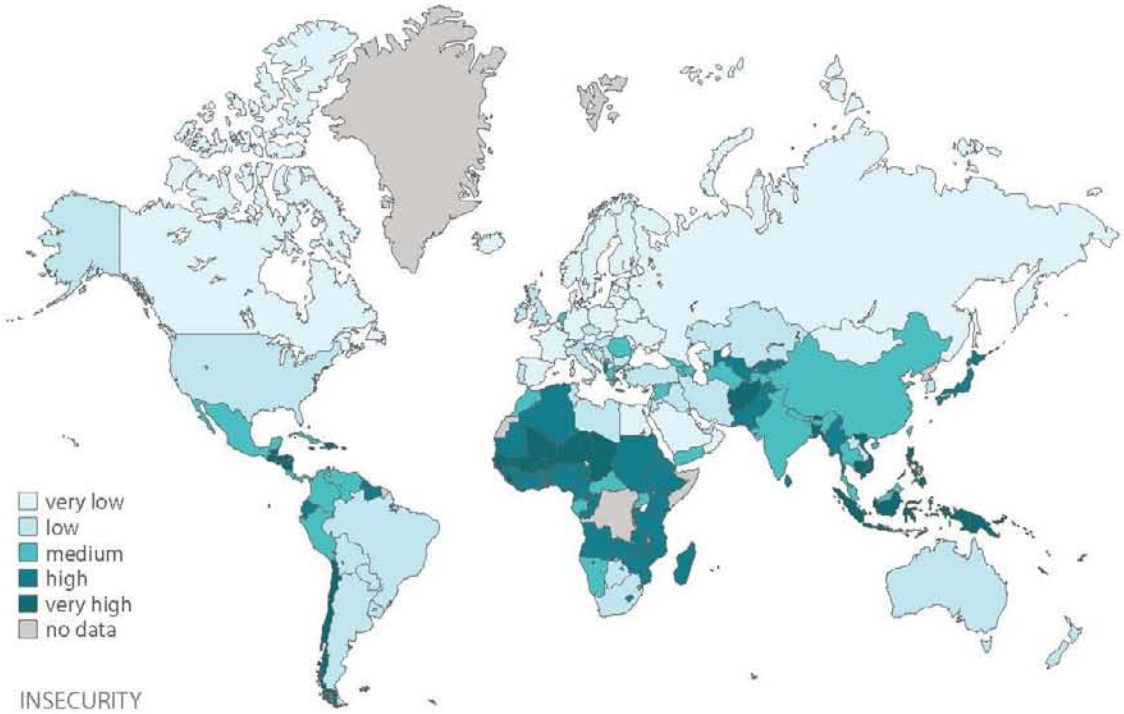


POLITICAL/ECONOMICAL

FIGURE 17:
The Political/Economic Index ranks countries on their risks in terms of global business relationship. This map helps to view poor potential trading hotspots.

Adapted by author from:

[35]POWER OF DATA VISUALIZATION. "Political and Economic Risk 2010." Last modified August 1, 2010. http://www.pdviz.com/political-and-economic-risk-map-2010.



INSECURITY

FIGURE 18:
The Insecurity Risk Index ranks countries to calculate the likelihood of harm from infrastructure and ability to handle those risks. This map helps to identify exposed hotspots.

Adapted by author from:

[37]WORLD ECONOMIC FORUM. "World Risk Report 2011." Accessed September 24, 2012. http://www.ehs.unu.edu/file/get/9018

17. POPULATION GROWTH:

"INCREASE IN THE NUMBER OF PEOPLE WHO INHABIT A TERRITORY OR STATE[38]"

This map is based on the United Nations Population Division. It assesses a country's annual change by percentage. Population increase can be due to increased birth or increased migration which is expected to increase with climate change.[39]

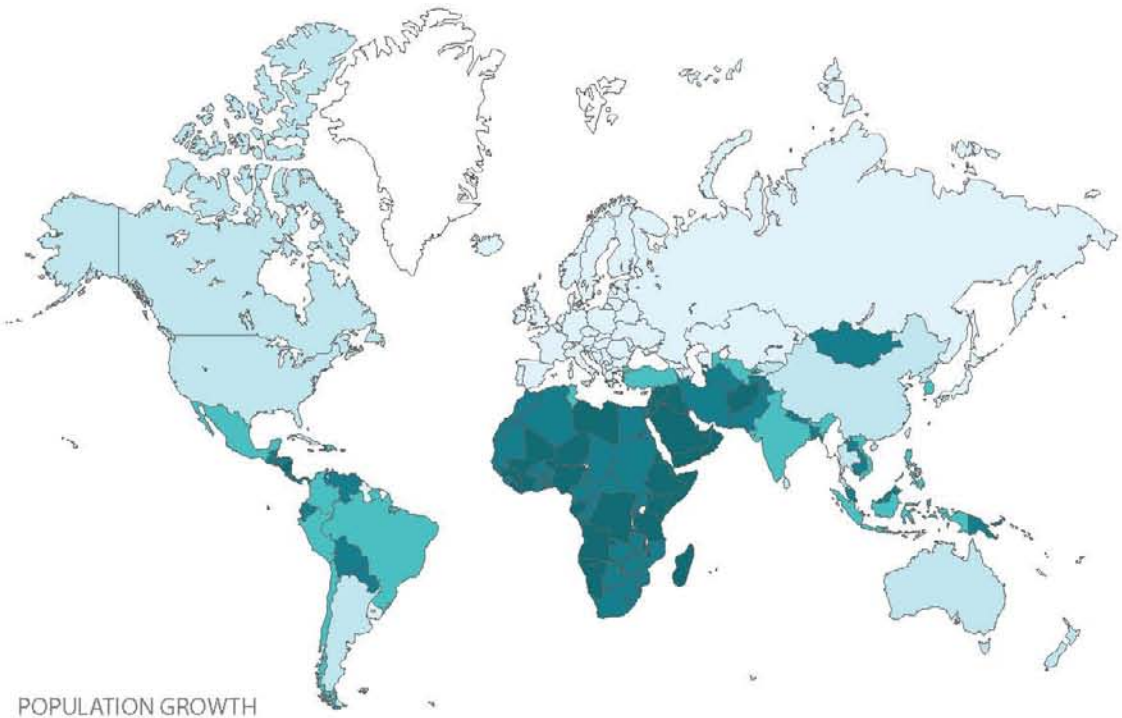
[38]DICTIONARY.COM. "Population Growth". Accessed October 24, 2012. http://dictionary.reference.com/browse/population+growth?s=t&ld=1093

18. EXPOSURE:

"TO LAY OPEN TO DANGER, ATTACK, HARM, ETC.; ENDANGER, IMPERIL, JEOPARDIZE[40]"

This map is based on the WorldRiskReport for 2011. It assesses a country's overall risk year by year by assigning a score of 1 to 196 by examining data such as susceptibility, exposure, lack of coping capacities, vulnerability, lack of adaptive capabilities, and insecurity. Exposure is comprised of three categories of risk: natural hazards, epidemics, and insect infestation.[41]

[40]DICTIONARY.COM. "Expose". Accessed October 24, 2012. http://dictionary.reference.com/browse/expose?s=t&ld=1093

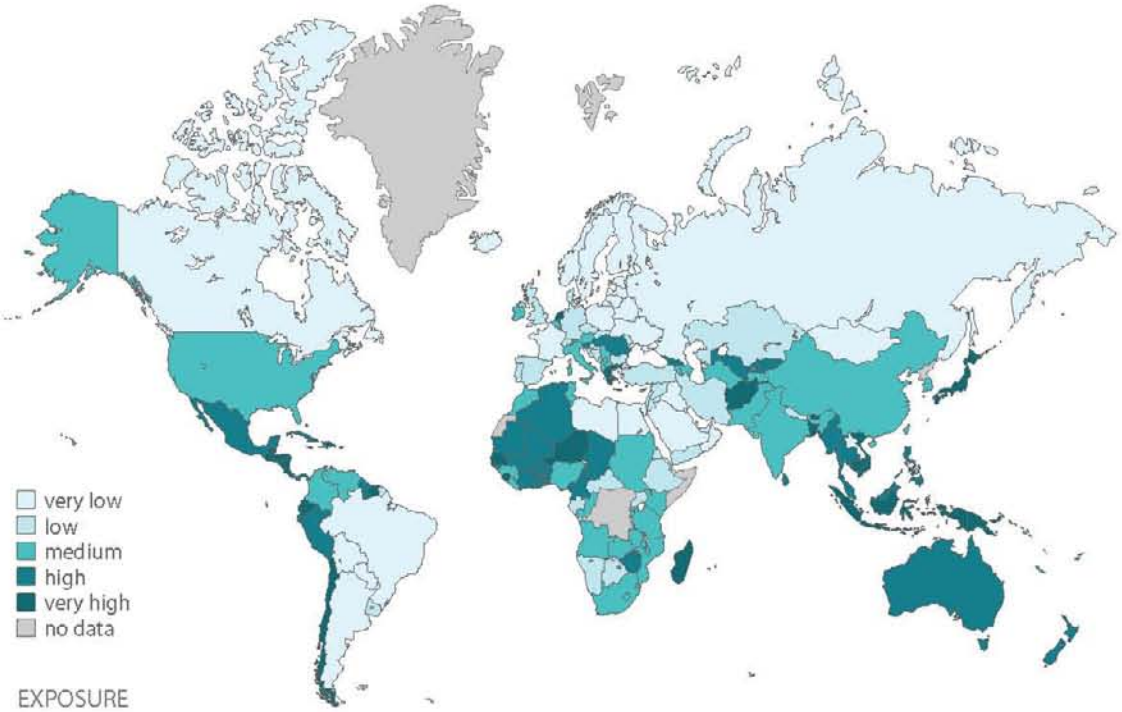


POPULATION GROWTH

FIGURE 19:
The Population Growth Index ranks countries on their average yearly population change from increased births or migration. This map helps to identify potentially stressed hotspots.

Adapted by author from:

[39]UNITED NATIONS POPULATION DIVISION. "Population Growth." Accessed September 30, 2012. http://zebu.uoregon.edu/1999/es202/archive/l13.html



EXPOSURE

FIGURE 20:
The Exposure Risk Index ranks countries to calculate the likelihood of harm from natural events, and ability to handle those risks. This map helps to identify exposed hotspots.

Adapted by author from:

[41]WORLD ECONOMIC FORUM. "World Risk Report 2011." Accessed September 24, 2012. http://www.ehs.unu.edu/file/get/9018

19. SEA LEVEL RISE:

"A CHANGE IN THE HORIZONTAL PLANE OR LEVEL CORRESPONDING TO THE SURFACE OF THE SEA AT MEAN LEVEL BETWEEN HIGH AND LOW TIDE[42]"

This map is based on the Center for Global Development's Sea Level Rise Map for 2011. With climate change, sea level rise has become an increasing risk for many low lying coastal regions and countries. Projections can help in risk prevention, but their accuracy is not yet certain.[43]

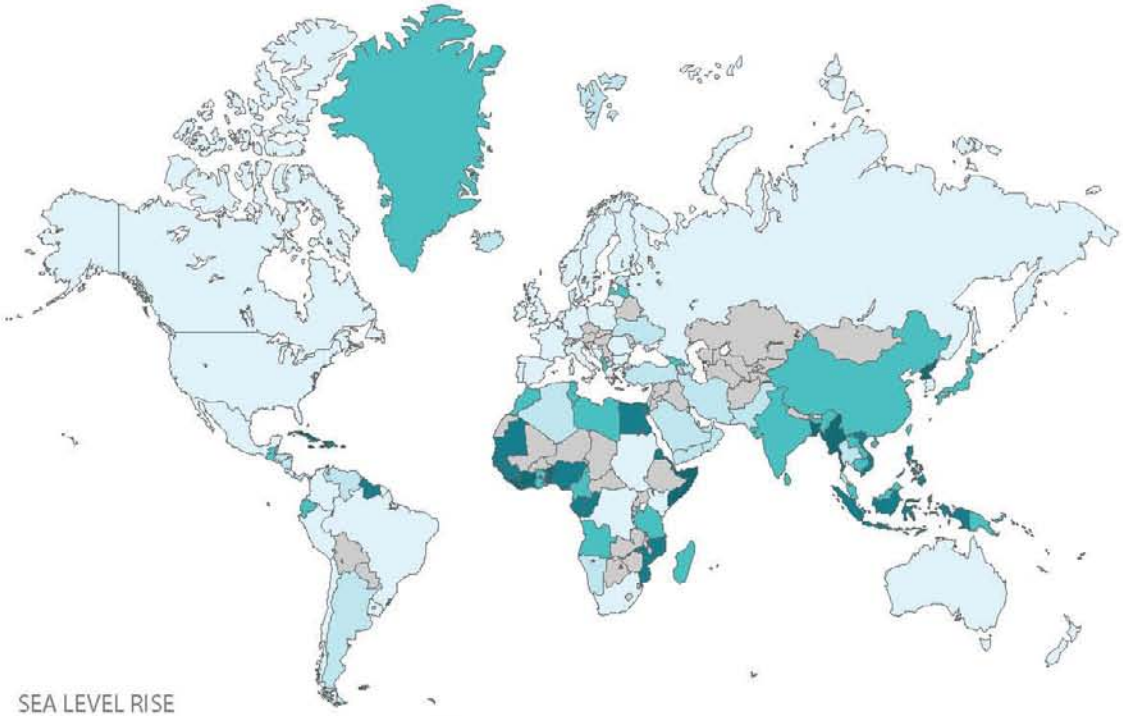
[42]DICTIONARY.COM. "Sea Level Rise". Accessed October 24, 2012. http://dictionary.reference.com/browse/sea+level?s=t&ld=1093

20. EXTINCT SPECIES

"THE DISAPPEARANCE OF A SPECIES FROM THE EARTH; A COMING TO AN END OR DYING OUT[44]"

This map is based on the IUCN's Red List Extinct Species Map for 2012. It takes into account all globally recorded extinct species for those countries that have kept a record for as long as they have kept those records.[45]

[44]DICTIONARY.COM. "Extinct Species". Accessed October 24, 2012. http://dictionary.reference.com/browse/extinction?fromAsk=true&o=100074

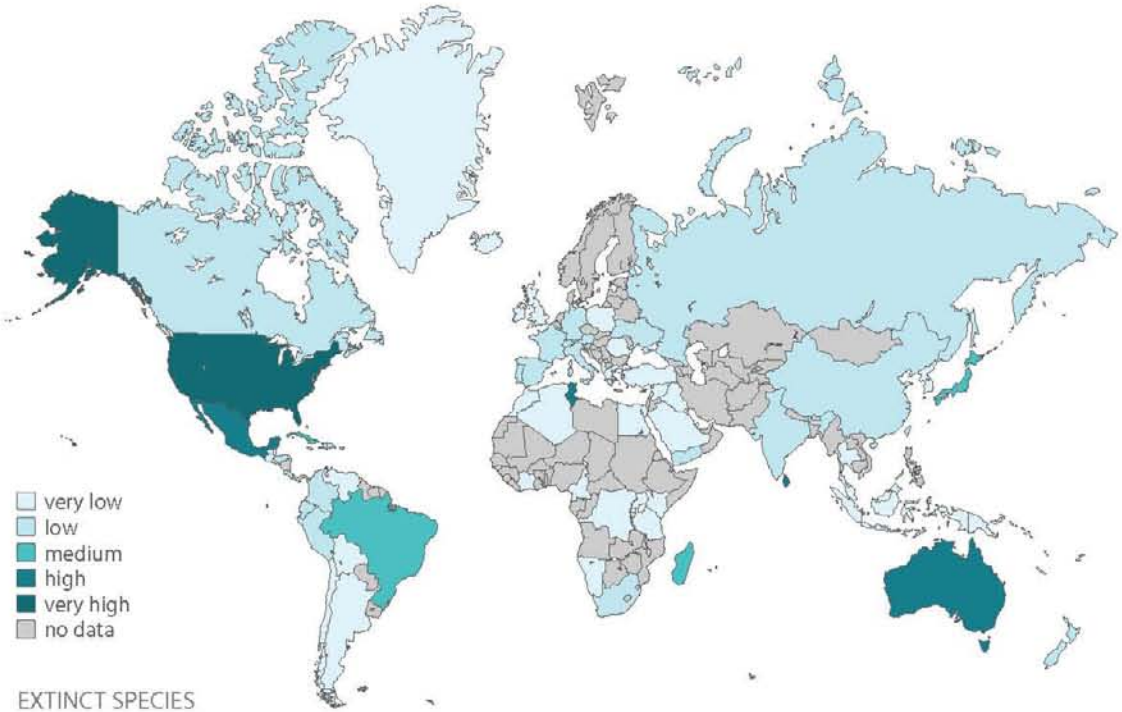


SEA LEVEL RISE

FIGURE 21:
The Sea Level Rise Index ranks coastal country's risk from rising water levels. This map helps to identify sea level rise hotspots.

Adapted by author from:

[43]CENTER FOR GLOBAL DEVELOPMENT. "Sea Level Rise." Accessed October 15, 2012. http://www.cgdev.org/section/topics/climate_change/mapping_the_impacts_of_climate_change



EXTINCT SPECIES

FIGURE 22:
The Extinct Species Index ranks countries by the amount of extinct species originated from them. This map helps to identify potential extinction hotspots.

Adapted by author from:

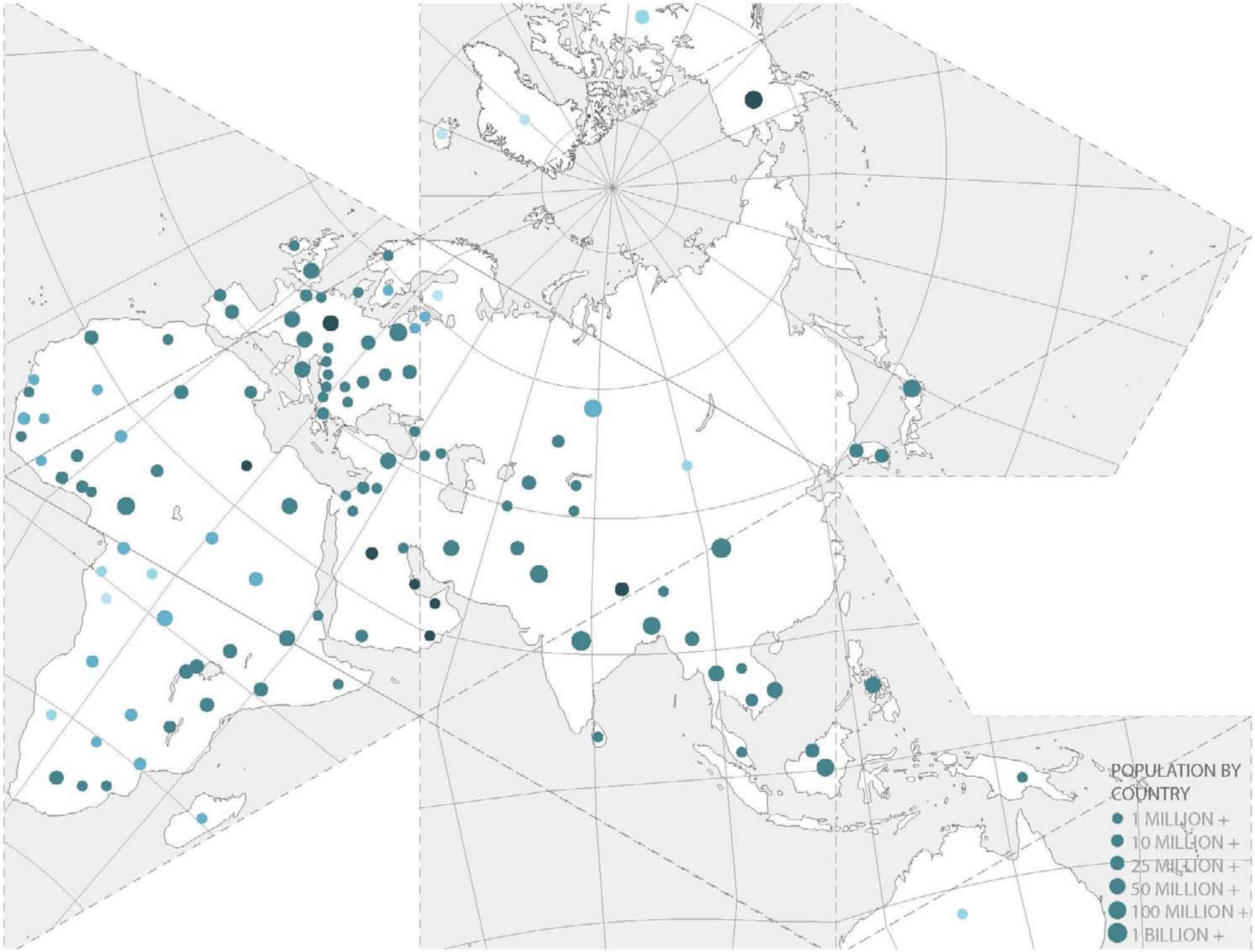
[44]THE GUARDIAN. "Where Species Went Extinct." Last modified September, 2012. http://www.guardian.co.uk/environment/interactive/2012/sep/03/extinct-and-endangered-species-interactive

SIZING UP THE COMPETITION

Once risk factors were calculated for the very high, high, medium, low, and very low quantiles, the data was graphically formatted to easily compare between the three measurements of risk. Additionally, the original maps used to analyze the risk factors have been extruded layer by layer to gain a better sense of where concentrated high and low risk zones are located. From this, each risk and measurement type can be studied individually or looked at systemically to understand larger over arching trends. **This, in essence creates the format for a new WorldGame, where playing with possible solutions results in mediating the negative effects of risk.**

FIGURE 23:

Author made image of Fuller's Dymaxion map


POPULATION BY COUNTRY
1 MILLION +
10 MILLION +
25 MILLION +
50 MILLION +
100 MILLION +
1 BILLION +

1. ECOLOGICAL FOOTPRINT DEBTORS:

FIGURE 24:

The Global Footprint Risk Index ranks countries on their consumption vs their biocapacity.

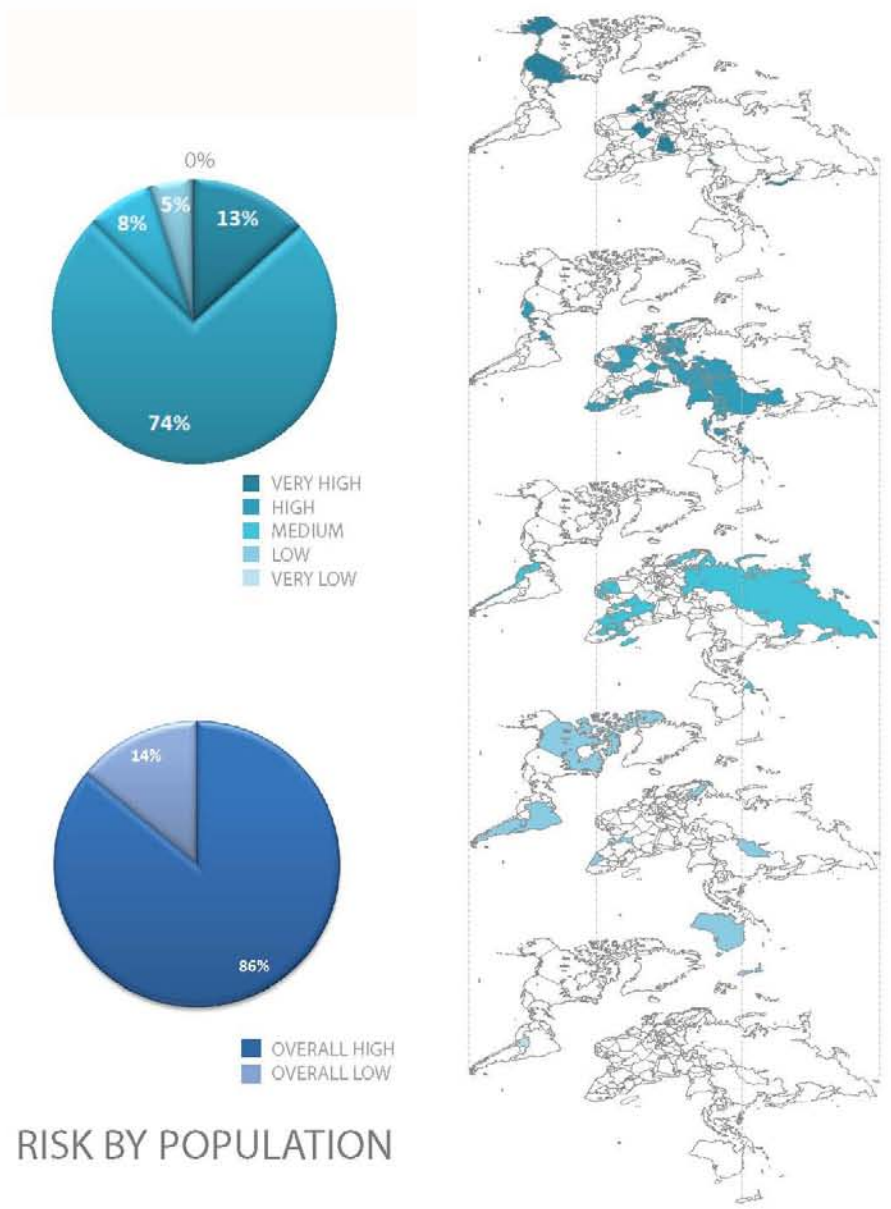
Adapted by author from:

GLOBAL FOOTPRINT NETWORK. "Ecological Footprint of Consumption Compared to Biocapacity." Accessed September 29, 2012.

WORLD ATLAS. "Countries of the World." Accessed October 22, 2012. http://www.worldatlas.com/aatlas/populations/ctypopls.htm

THE WORLD BANK. "Land Area (sq. km.)." Accessed October 22, 2012. http://data.worldbank.org/indicator/AG.LND.TOTL.K2

SEA AROUND US PROJECT. "Exclusive Economic Zones." Accessed October 24, 2012. http://www.seaaroundus.org/eez/



2. FOSSIL FUEL DEPENDENCY:

FIGURE 25:

The Fossil Fuel Dependency Index ranks countries on their consumption of renewable vs nonrenewable sources.

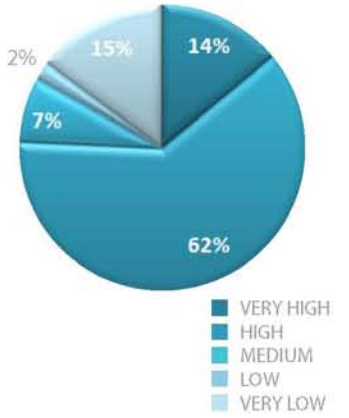
Adapted by author from:

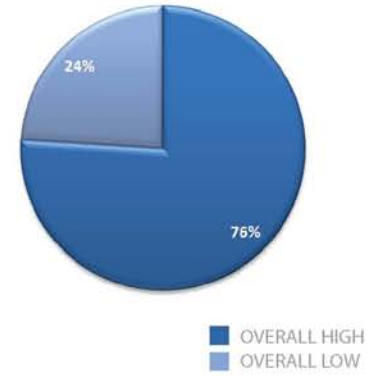
GEOCURRENTS. "Mapping Renewable Electricity Generation." Accessed September 29, 2012. http://geocurrents.info/geonotes/mapping-renewable-electricity-generation

WORLD ATLAS. "Countries of the World." Accessed October 22, 2012. http://www.worldatlas.com/aatlas/populations/ctypopls.htm

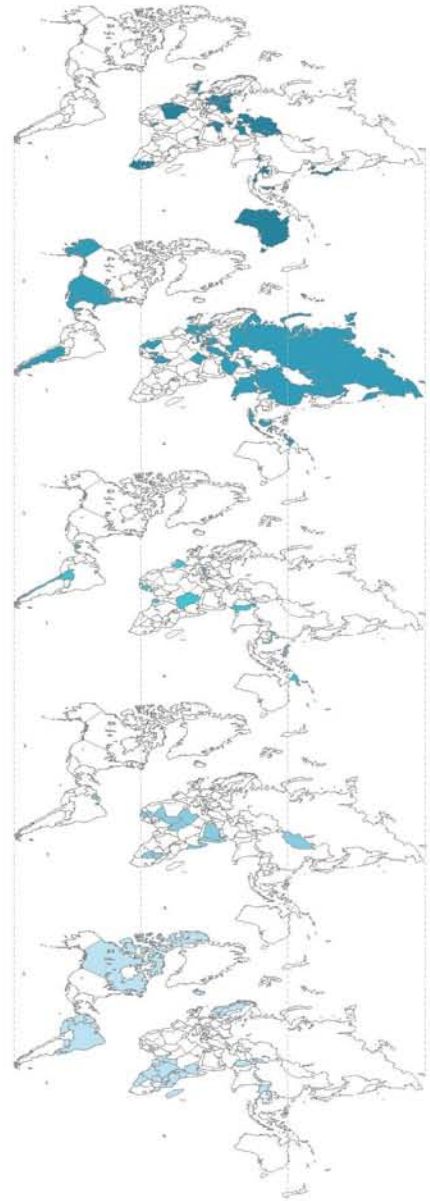
THE WORLD BANK. "Land Area (sq. km.)." Accessed October 22, 2012. http://data.worldbank.org/indicator/AG.LND.TOTL.K2

SEA AROUND US PROJECT. "Exclusive Economic Zones." Accessed October 24, 2012. http://www.seaaroundus.org/eez/





RISK BY POPULATION



3. EXTREME WEATHER:

FIGURE 26:

The Extreme Weather Risk Index ranks countries on their risk to a variety of weather events.

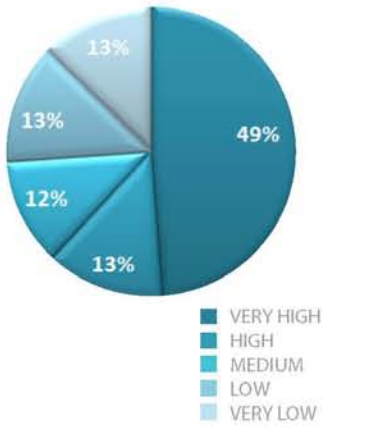
Adapted by author from:

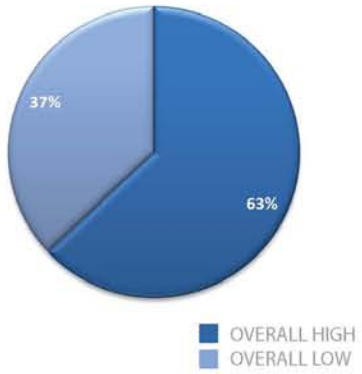
CENTER FOR GLOBAL DEVELOPMENT. "Extreme Weather." Accessed October 15, 2012. http://www.cgdev.org/section/topics/climate_change/mapping_the_impacts_of_climate_change

WORLD ATLAS. "Countries of the World." Accessed October 22, 2012. http://www.worldatlas.com/aatlas/populations/ctypopls.htm

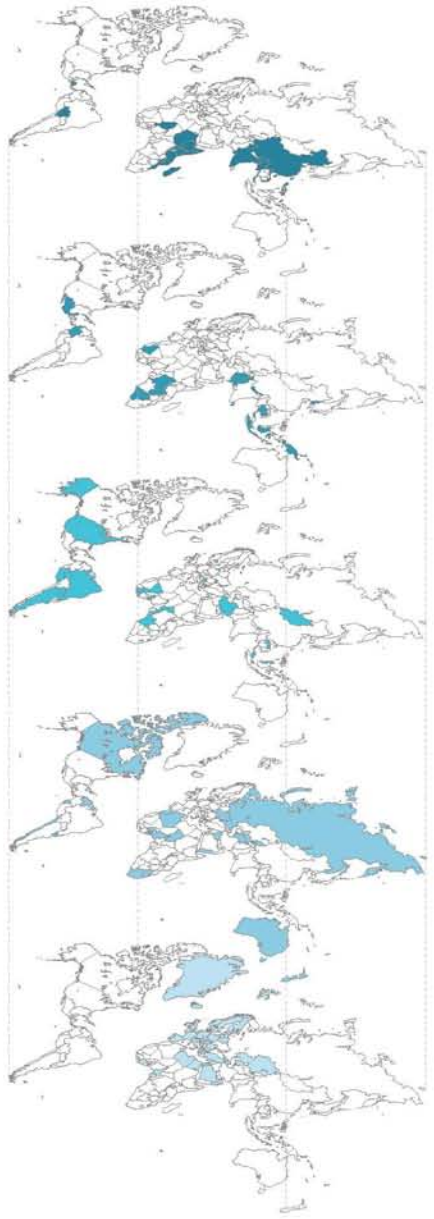
THE WORLD BANK. "Land Area (sq. km.)." Accessed October 22, 2012. http://data.worldbank.org/indicator/AG.LND.TOTL.K2

SEA AROUND US PROJECT. "Exclusive Economic Zones." Accessed October 24, 2012. http://www.seaaroundus.org/eez/





RISK BY POPULATION



4. ENDANGERED SPECIES:

FIGURE 27:

The Endangered Species Index ranks countries by the amount of endangered species they contain.

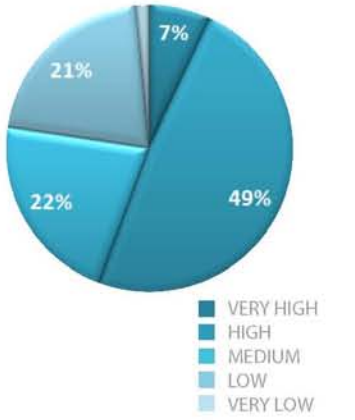
Adapted by author from:

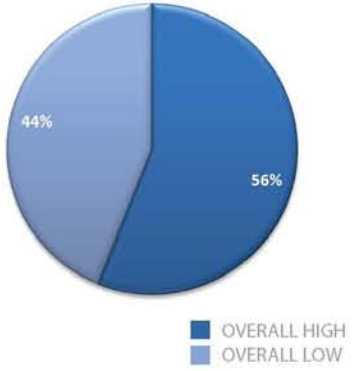
THE GUARDIAN. "Where Species Went Extinct." Last modified September, 2012. http://www.guardian.co.uk/environment/interactive/2012/sep/03/extinct-and-endangered-species-interactive

WORLD ATLAS. "Countries of the World." Accessed October 22, 2012. http://www.worldatlas.com/aatlas/populations/ctypopls.htm

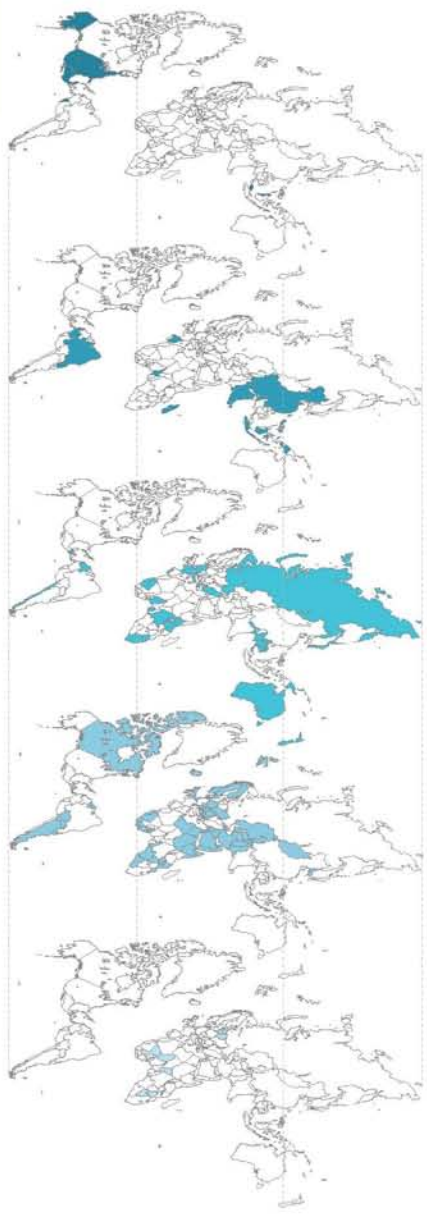
THE WORLD BANK. "Land Area (sq. km.)." Accessed October 22, 2012. http://data.worldbank.org/indicator/AG.LND.TOTL.K2

SEA AROUND US PROJECT. "Exclusive Economic Zones." Accessed October 24, 2012. http://www.seaaroundus.org/eez/





RISK BY POPULATION



5. NON-COMMUNICABLE DISEASE:

FIGURE 28:

The Non-Communicable Disease Index ranks countries by the amount of NCD deaths and the probability for future deaths.

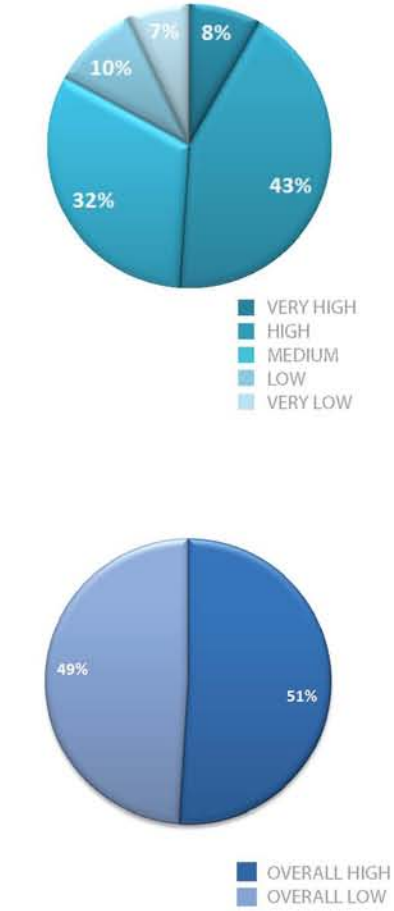
Adapted by author from:

WORLD HEALTH ORGANIZATION. "Probability of Dying from a Non-Communicable Disease." Accessed September 22, 2012. http://humanosphere.kplu.org/wp-content/uploads/2012/06/NCDmap.png

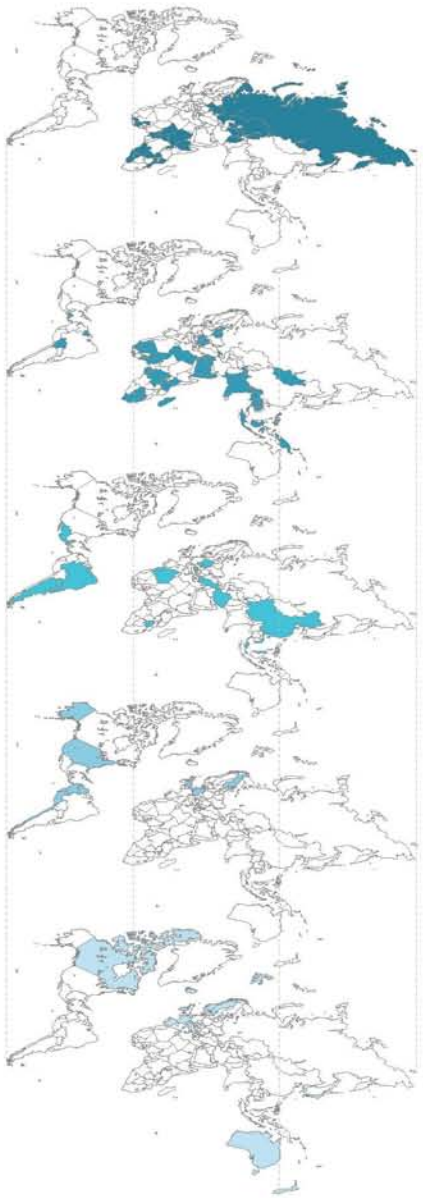
WORLD ATLAS. "Countries of the World." Accessed October 22, 2012. http://www.worldatlas.com/aatlas/populations/ctypopls.htm

THE WORLD BANK. "Land Area (sq. km.)." Accessed October 22, 2012. http://data.worldbank.org/indicator/AG.LND.TOTL.K2

SEA AROUND US PROJECT. "Exclusive Economic Zones." Accessed October 24, 2012. http://www.seaaroundus.org/eez/



RISK BY POPULATION



6. WATER SCARCITY:

FIGURE 29:

The Water Scarcity Index ranks countries by their lack of potable drinking water.

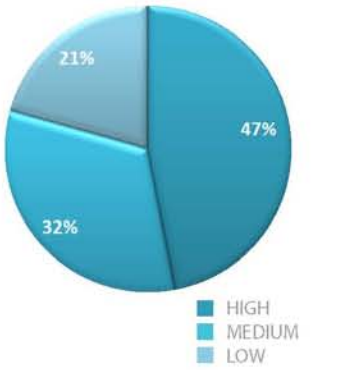
Adapted by author from:

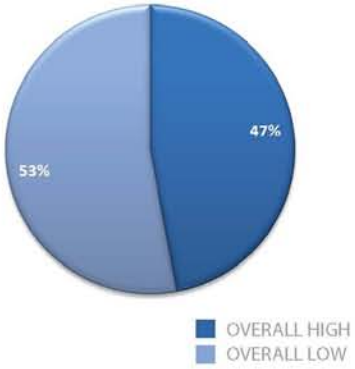
WATER WOES. "Water Scarcity." Accessed September 22, 2012. http://whyfiles.org/131fresh_water/2.html

WORLD ATLAS. "Countries of the World." Accessed October 22, 2012. http://www.worldatlas.com/aatlas/populations/ctypopls.htm

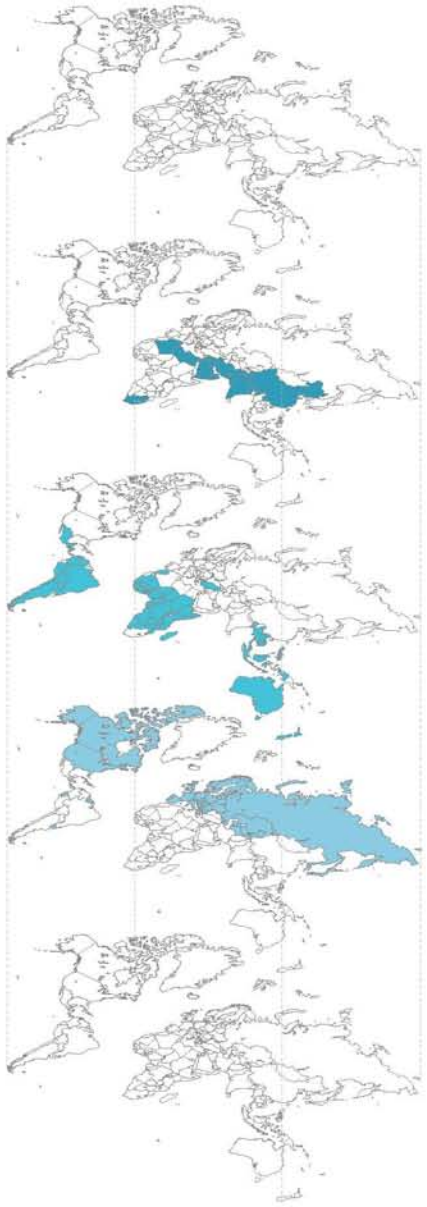
THE WORLD BANK. "Land Area (sq. km.)." Accessed October 22, 2012. http://data.worldbank.org/indicator/AG.LND.TOTL.K2

SEA AROUND US PROJECT. "Exclusive Economic Zones." Accessed October 24, 2012. http://www.seaaroundus.org/eez/





RISK BY POPULATION



7. LACK OF COPING CAPABILITIES:

FIGURE 30:

Lack of coping capabilities is comprised of three categories of risk: government and authorities (corruption), medical services (number of physicians and hospital beds), material coverage (insurances).

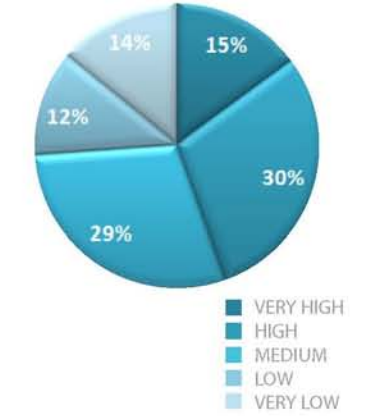
Adapted by author from:

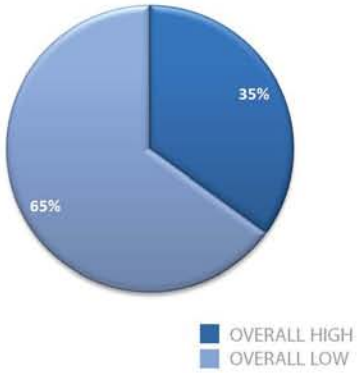
WORLD ECONOMIC FORUM. "World Risk Report 2011." Accessed September 24, 2012. http://www.ehs.unu.edu/file/get/9018

WORLD ATLAS. "Countries of the World." Accessed October 22, 2012. http://www.worldatlas.com/aatlas/populations/ctypopls.htm

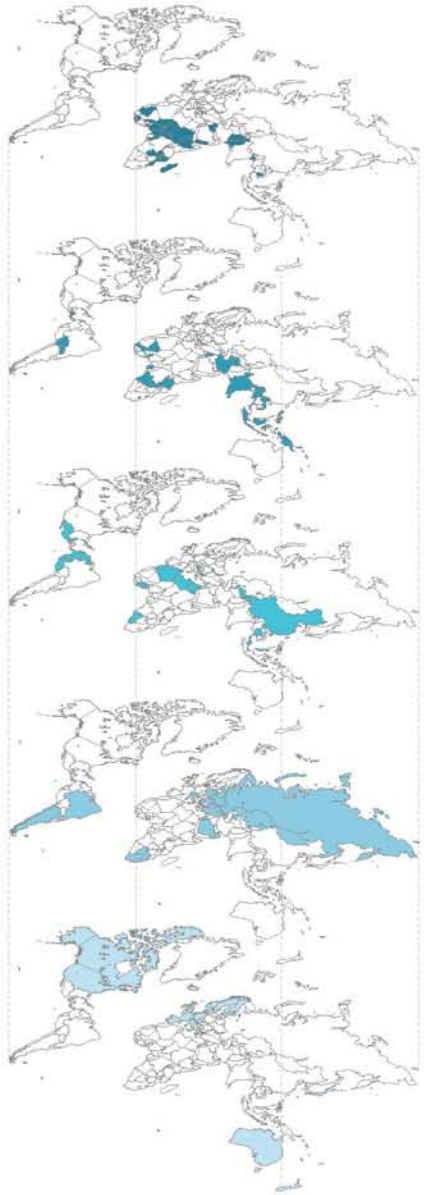
THE WORLD BANK. "Land Area (sq. km.)." Accessed October 22, 2012. http://data.worldbank.org/indicator/AG.LND.TOTL.K2

SEA AROUND US PROJECT. "Exclusive Economic Zones." Accessed October 24, 2012. http://www.seaaroundus.org/eez/





RISK BY POPULATION



8. LACK OF ADAPTIVE CAPACITIES:

FIGURE 31:

Lack of adaptation is comprised of four categories of risk: education and research, gender equity, investment, and environmental status/ecosystem protection.

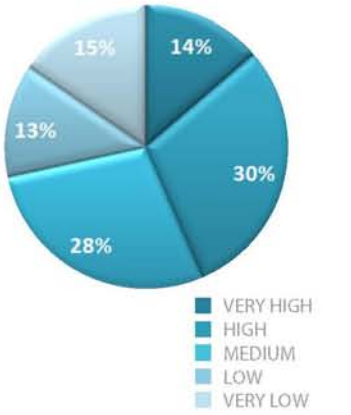
Adapted by author from:

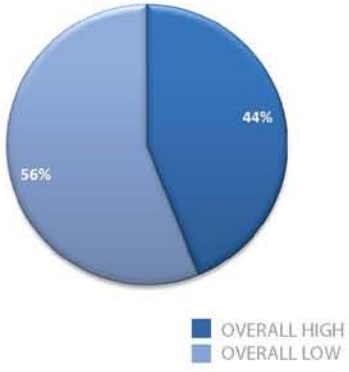
WORLD ECONOMIC FORUM. "World Risk Report 2011." Accessed September 24, 2012. http://www.ehs.unu.edu/file/get/9018

WORLD ATLAS. "Countries of the World." Accessed October 22, 2012. http://www.worldatlas.com/aatlas/populations/ctypopls.htm

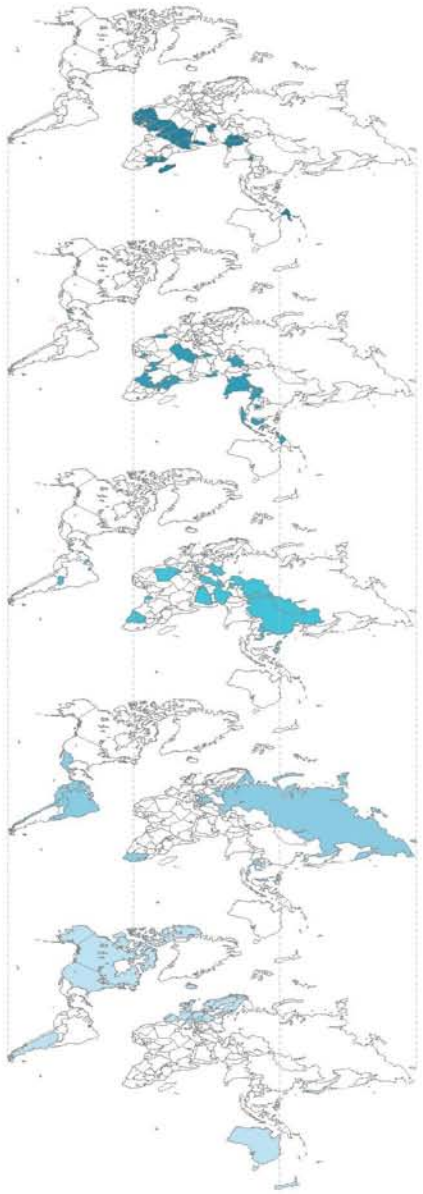
THE WORLD BANK. "Land Area (sq. km.)." Accessed October 22, 2012. http://data.worldbank.org/indicator/AG.LND.TOTL.K2

SEA AROUND US PROJECT. "Exclusive Economic Zones." Accessed October 24, 2012. http://www.seaaroundus.org/eez/





RISK BY POPULATION



9. SUSCEPTIBILITY:

FIGURE 32:

Susceptibility is comprised of four categories of risk: public infrastructure, nutrition, poverty and dependence, and economic capacity and income distribution.

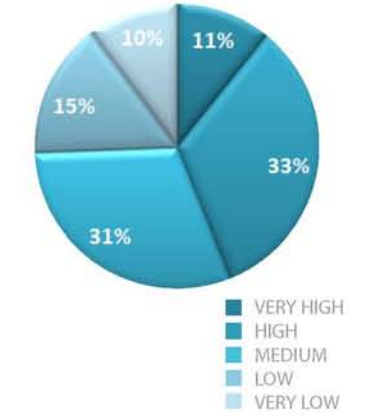
Adapted by author from:

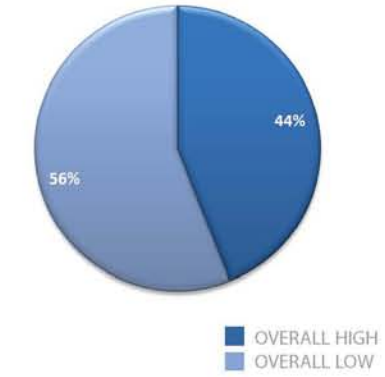
WORLD ECONOMIC FORUM. "World Risk Report 2011." Accessed September 24, 2012. http://www.ehs.unu.edu/file/get/9018

WORLD ATLAS. "Countries of the World." Accessed October 22, 2012. http://www.worldatlas.com/aatlas/populations/ctypopls.htm

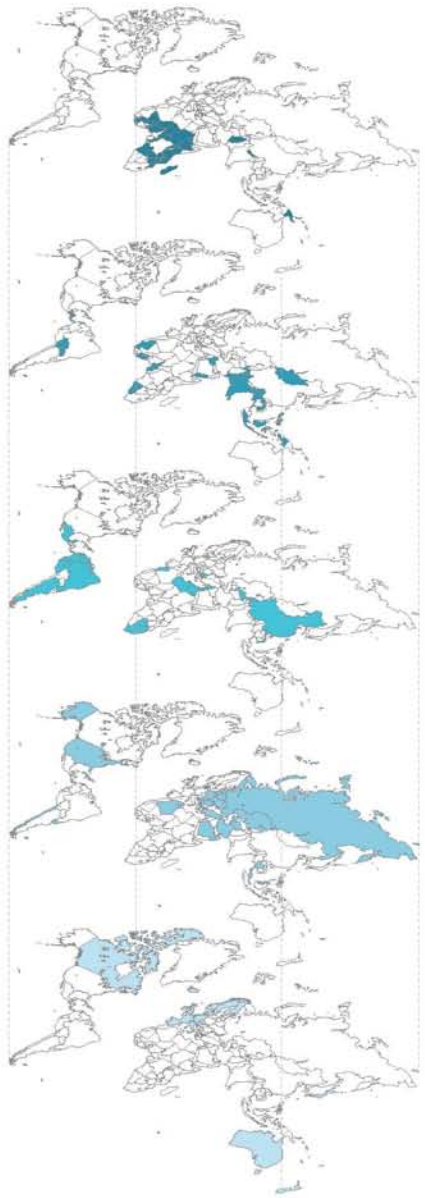
THE WORLD BANK. "Land Area (sq. km.)." Accessed October 22, 2012. http://data.worldbank.org/indicator/AG.LND.TOTL.K2

SEA AROUND US PROJECT. "Exclusive Economic Zones." Accessed October 24, 2012. http://www.seaaroundus.org/eez/





RISK BY POPULATION



10. VULNERABILITY:

FIGURE 33:

Vulnerability is comprised likelihood of suffering harm, lack of capacities to reduce negative consequences during a disaster, and lack of capacities for long-term strategies for societal change.

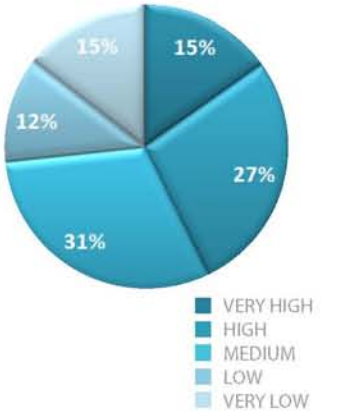
Adapted by author from:

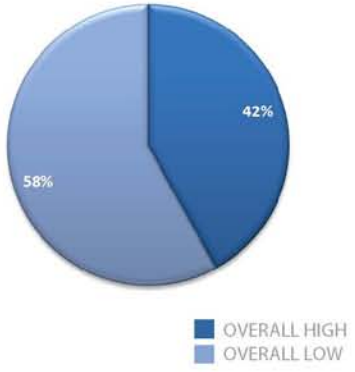
WORLD ECONOMIC FORUM. "World Risk Report 2011." Accessed September 24, 2012. http://www.ehs.unu.edu/file/get/9018

WORLD ATLAS. "Countries of the World." Accessed October 22, 2012. http://www.worldatlas.com/aatlas/populations/ctypopls.htm

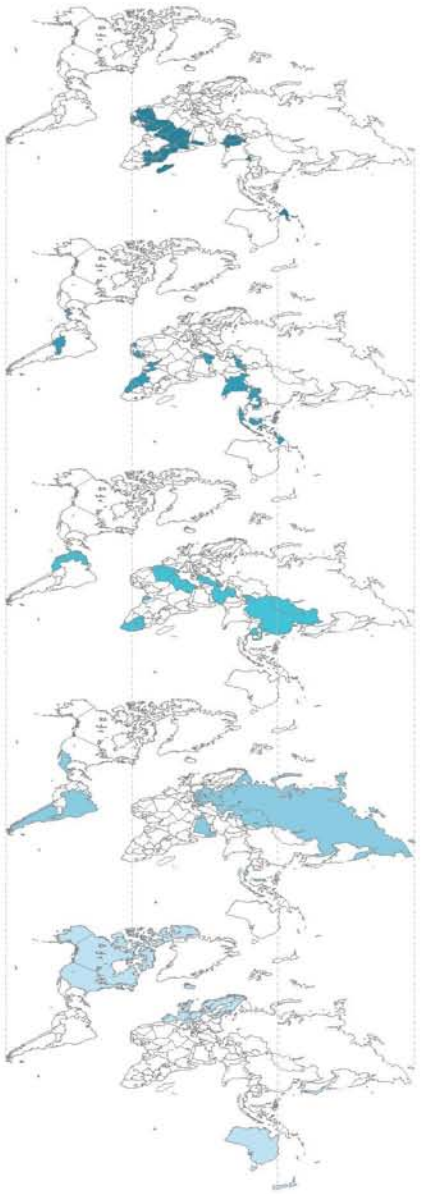
THE WORLD BANK. "Land Area (sq. km.)." Accessed October 22, 2012. http://data.worldbank.org/indicator/AG.LND.TOTL.K2

SEA AROUND US PROJECT. "Exclusive Economic Zones." Accessed October 24, 2012. http://www.seaaroundus.org/eez/





RISK BY POPULATION



11. COMMUNICABLE DISEASE:

FIGURE 34:

The Infectious Disease Index ranks countries based on deaths resulting from infectious and parasitic diseases per 10,000 inhabitants.

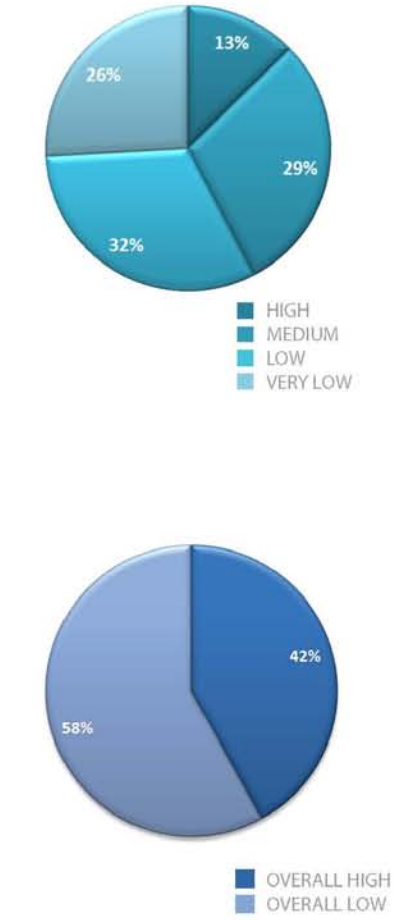
Adapted by author from:

GLOBAL FOOTPRINT NETWORK. "Ecological Footprint of Consumption Compared to Biocapacity." Accessed September 29, 2012.

WORLD ATLAS. "Countries of the World." Accessed October 22, 2012. http://www.worldatlas.com/aatlas/populations/ctypopls.htm

THE WORLD BANK. "Land Area (sq. km.)." Accessed October 22, 2012. http://data.worldbank.org/indicator/AG.LND.TOTL.K2

SEA AROUND US PROJECT. "Exclusive Economic Zones." Accessed October 24, 2012. http://www.seaaroundus.org/eez/



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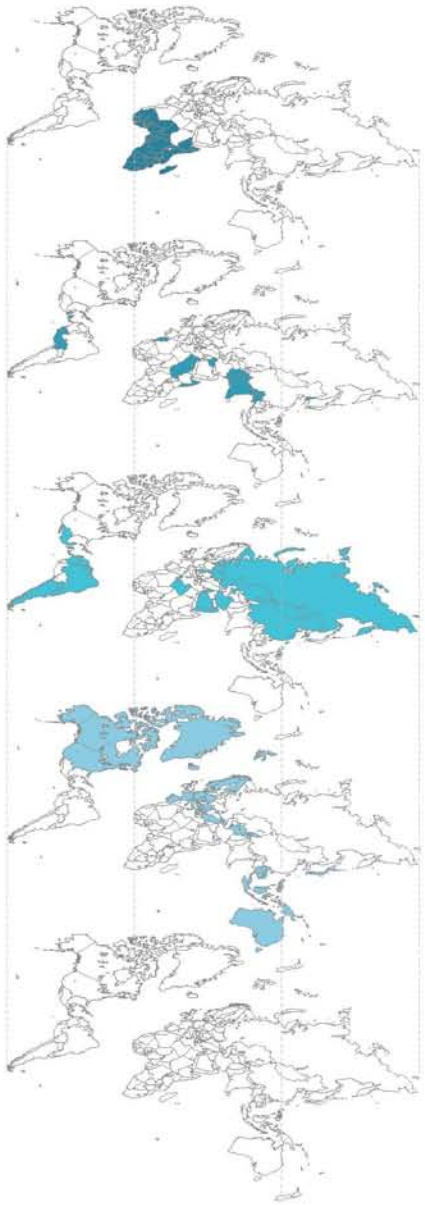


12. TERRORISM:

FIGURE 35:

The Terrorism Risk Index ranks 137 countries to calculate the frequency and lethality of terrorist incidents prior to April 1, 2011.

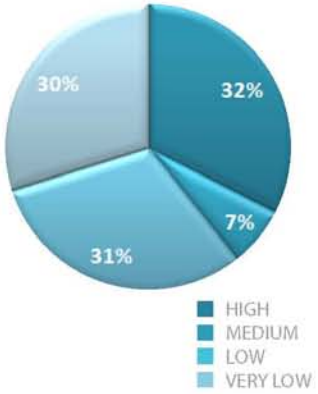
Adapted by author from:

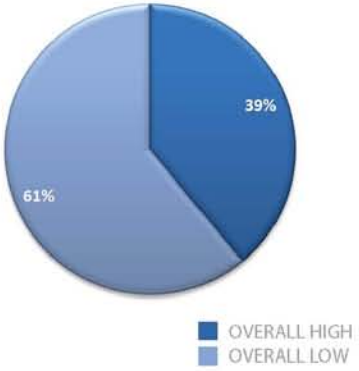
MAPLECROFT. "Political Risk Index." Accessed October 17, 2012. http://maplecroft.com/about/news/pra_2011.html.

WORLD ATLAS. "Countries of the World." Accessed October 22, 2012. http://www.worldatlas.com/aatlas/populations/ctypopls.htm

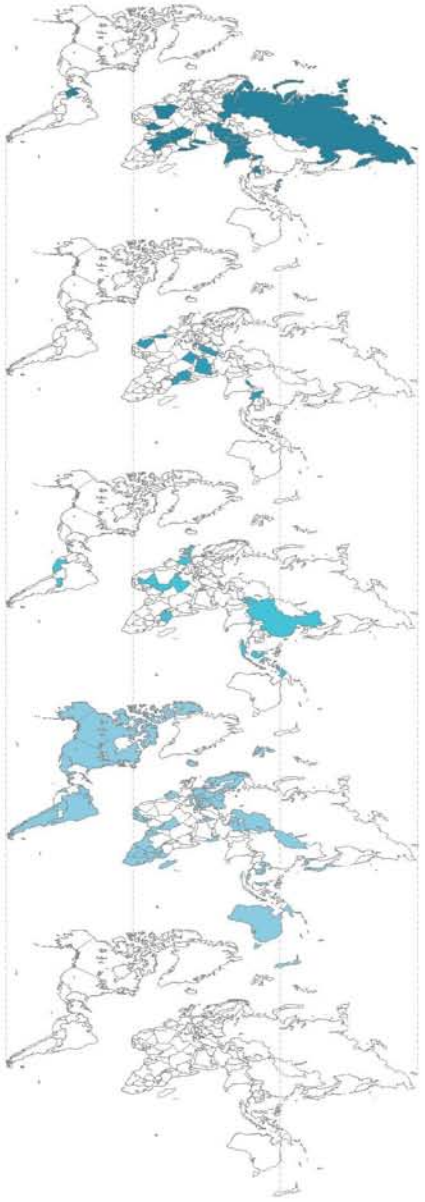
THE WORLD BANK. "Land Area (sq. km.)." Accessed October 22, 2012. http://data.worldbank.org/indicator/AG.LND.TOTL.K2

SEA AROUND US PROJECT. "Exclusive Economic Zones." Accessed October 24, 2012. http://www.seaaroundus.org/eez/





RISK BY POPULATION



13. FOOD DEPRIVATION:

FIGURE 36:

The Food Deprivation Index ranks countries on their risks of undernourishment.

Adapted by author from:

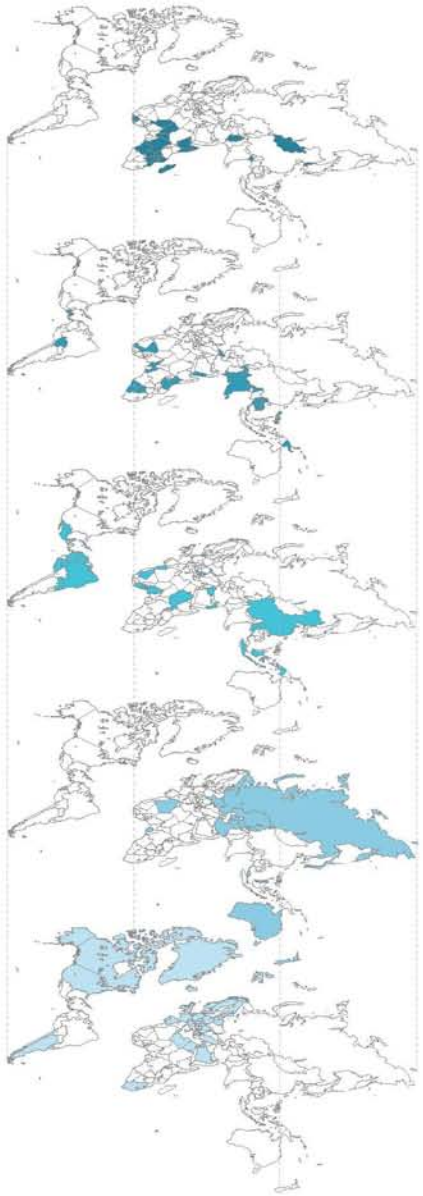
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS: ANIMAL PRODUCTION AND HEALTH DIVISION. "Growth in Demand for Eggs 2000-2030." Last modified September, 2011. http://www.fao.org/docrep/x8200e/x8200e03.htm

WORLD ATLAS. "Countries of the World." Accessed October 22, 2012. http://www.worldatlas.com/aatlas/populations/ctypopls.htm

THE WORLD BANK. "Land Area (sq. km.)." Accessed October 22, 2012. http://data.worldbank.org/indicator/AG.LND.TOTL.K2

SEA AROUND US PROJECT. "Exclusive Economic Zones." Accessed October 24, 2012. http://www.seaaroundus.org/eez/

RISK BY POPULATION



14. AGRICULTURAL PRODUCTIVITY LOSS:

FIGURE 37:

The Agricultural Productivity Index ranks countries on their risks of losing future crops.

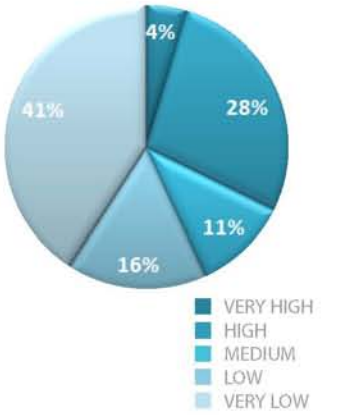
Adapted by author from:

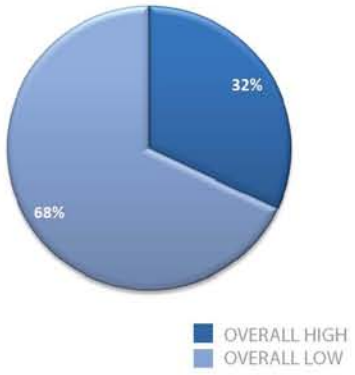
CENTER FOR GLOBAL DEVELOPMENT. "Agricultural Productivity Loss." Accessed October 15, 2012. http://www.cgdev.org/section/topics/climate_change/mapping_the_impacts_of_climate_change

WORLD ATLAS. "Countries of the World." Accessed October 22, 2012. http://www.worldatlas.com/aatlas/populations/ctypopls.htm

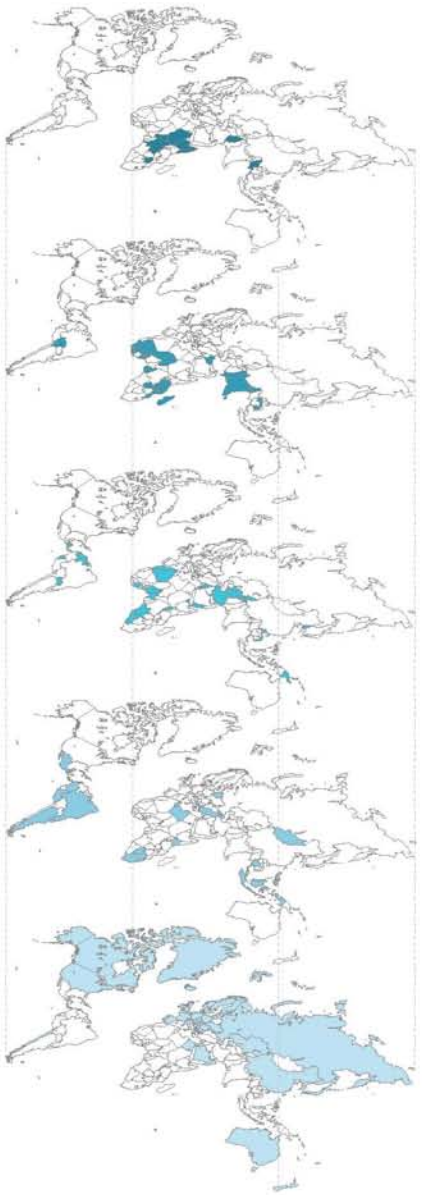
THE WORLD BANK. "Land Area (sq. km.)." Accessed October 22, 2012. http://data.worldbank.org/indicator/AG.LND.TOTL.K2

SEA AROUND US PROJECT. "Exclusive Economic Zones." Accessed October 24, 2012. http://www.seaaroundus.org/eez/





RISK BY POPULATION



15. POLITICAL/ECONOMICAL:

FIGURE 38:

The Political/Economic Index ranks countries on their risks in terms of global business relationship.

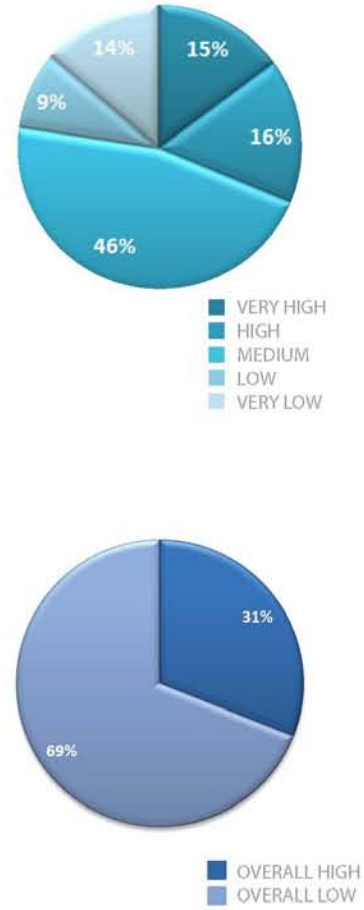
Adapted by author from:

POWER OF DATA VISUALIZATION. "Political and Economic Risk 2010." Last modified August 1, 2010. http://www.pdviz.com/political-and-economic-risk-map-2010.

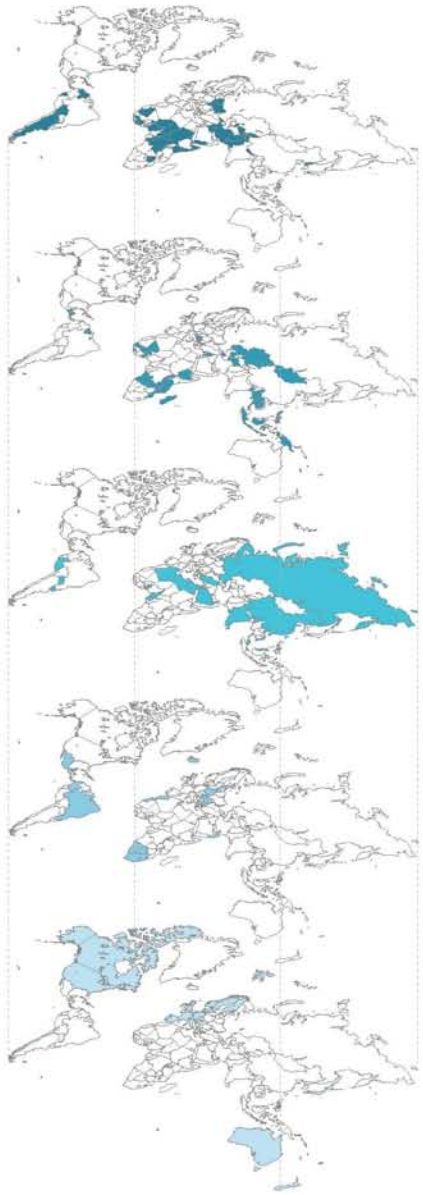
WORLD ATLAS. "Countries of the World." Accessed October 22, 2012. http://www.worldatlas.com/aatlas/populations/ctypopls.htm

THE WORLD BANK. "Land Area (sq. km.)." Accessed October 22, 2012. http://data.worldbank.org/indicator/AG.LND.TOTL.K2

SEA AROUND US PROJECT. "Exclusive Economic Zones." Accessed October 24, 2012. http://www.seaaroundus.org/eez/



RISK BY POPULATION



16. INSECURITY:

FIGURE 39:

The Insecurity Risk Index ranks countries to calculate the likelihood of harm from infrastructure and ability to handle those risks.

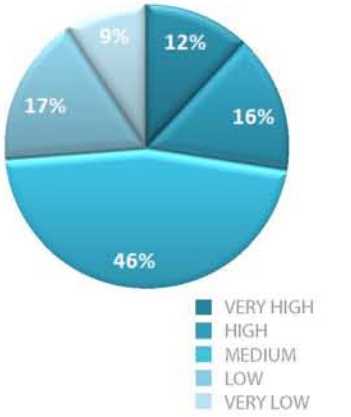
Adapted by author from:

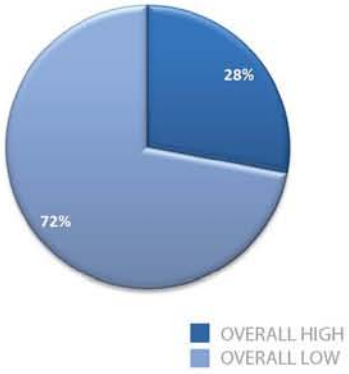
WORLD ECONOMIC FORUM. "World Risk Report 2011." Accessed September 24, 2012. http://www.ehs.unu.edu/file/get/9018

WORLD ATLAS. "Countries of the World." Accessed October 22, 2012. http://www.worldatlas.com/aatlas/populations/ctypopls.htm

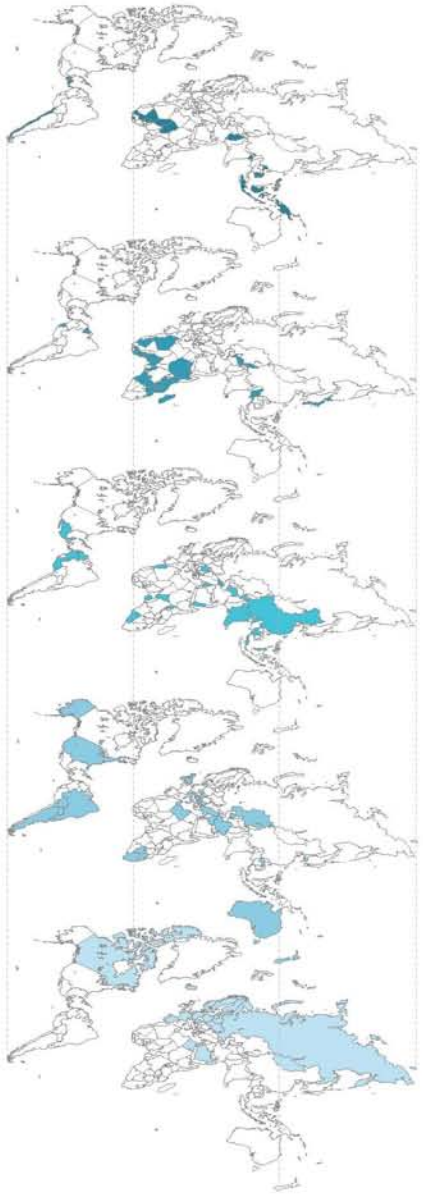
THE WORLD BANK. "Land Area (sq. km.)." Accessed October 22, 2012. http://data.worldbank.org/indicator/AG.LND.TOTL.K2

SEA AROUND US PROJECT. "Exclusive Economic Zones." Accessed October 24, 2012. http://www.seaaroundus.org/eez/





RISK BY POPULATION



17. POPULATION GROWTH:

FIGURE 40:

The Population Growth Index ranks countries on their average yearly population change from increased births or migration.

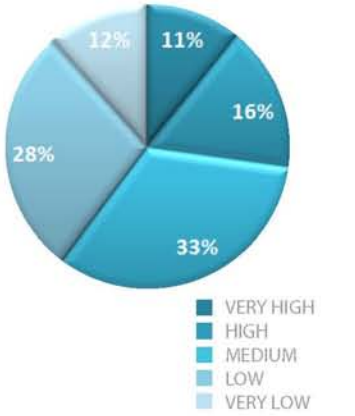
Adapted by author from:

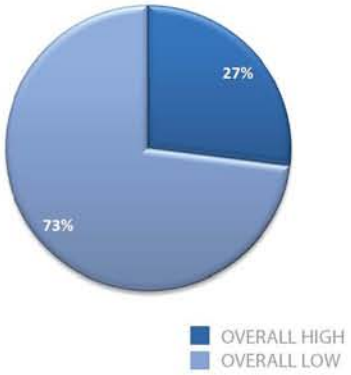
UNITED NATIONS POPULATION DIVISION. "Population Growth." Accessed September 30, 2012. http://zebu.uoregon.edu/1999/es202/archive/l13.html

WORLD ATLAS. "Countries of the World." Accessed October 22, 2012. http://www.worldatlas.com/aatlas/populations/ctypopls.htm

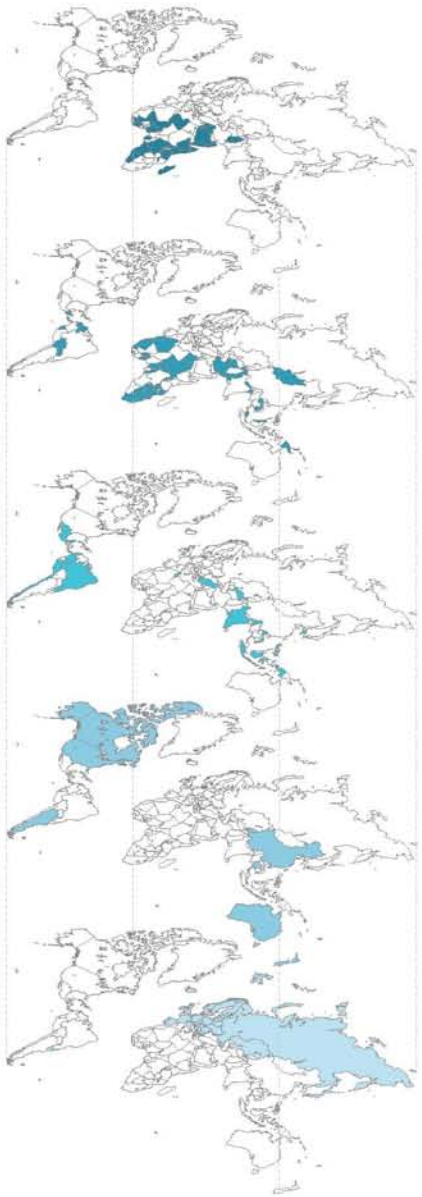
THE WORLD BANK. "Land Area (sq. km.)." Accessed October 22, 2012. http://data.worldbank.org/indicator/AG.LND.TOTL.K2

SEA AROUND US PROJECT. "Exclusive Economic Zones." Accessed October 24, 2012. http://www.seaaroundus.org/eez/





RISK BY POPULATION



18. EXPOSURE:

FIGURE 41:

The Exposure Risk Index ranks countries to calculate the likelihood of harm from natural events, and ability to handle those risks.

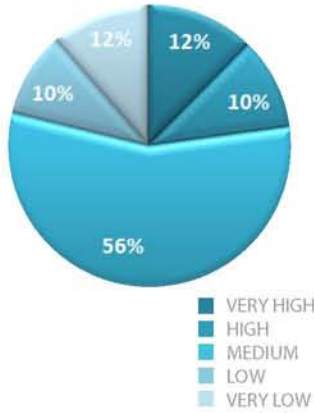
Adapted by author from:

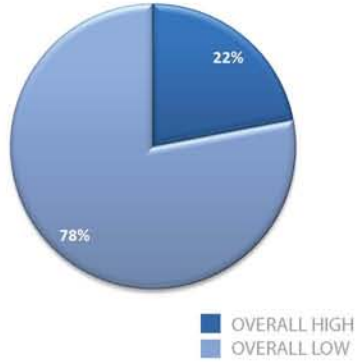
WORLD ECONOMIC FORUM. "World Risk Report 2011." Accessed September 24, 2012. http://www.ehs.unu.edu/file/get/9018

WORLD ATLAS. "Countries of the World." Accessed October 22, 2012. http://www.worldatlas.com/aatlas/populations/ctypopls.htm

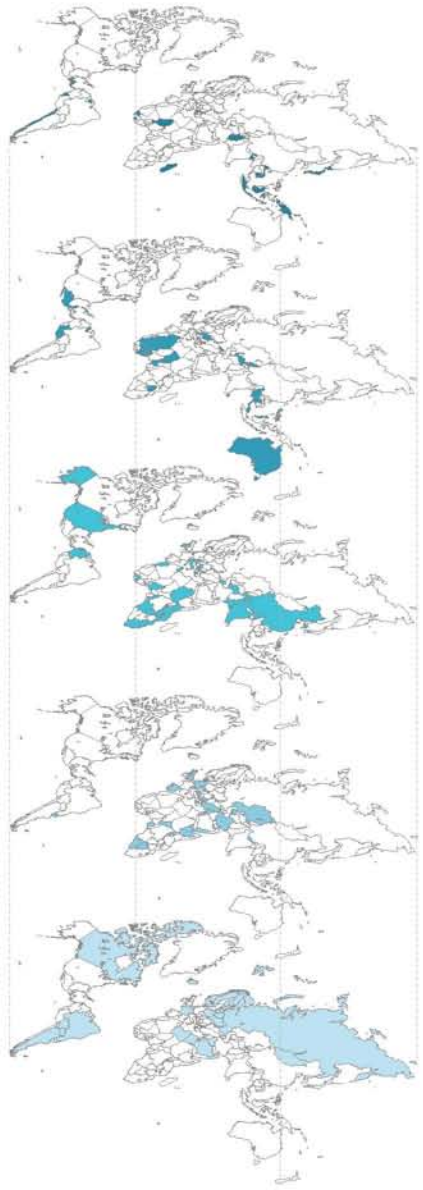
THE WORLD BANK. "Land Area (sq. km.)." Accessed October 22, 2012. http://data.worldbank.org/indicator/AG.LND.TOTL.K2

SEA AROUND US PROJECT. "Exclusive Economic Zones." Accessed October 24, 2012. http://www.seaaroundus.org/eez/





RISK BY POPULATION



19. SEA LEVEL RISE:

FIGURE 42:

The Sea Level Rise Index ranks coastal country's risk from rising water levels.

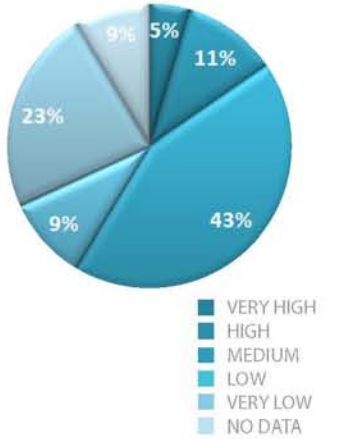
Adapted by author from:

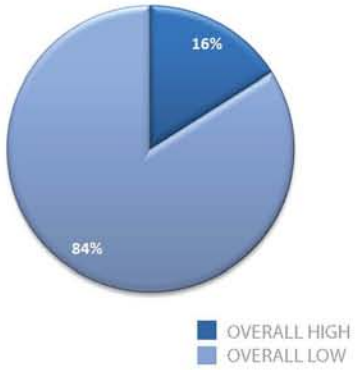
CENTER FOR GLOBAL DEVELOPMENT. "Sea Level Rise." Accessed October 15, 2012. http://www.cgdev.org/section/topics/climate_change/mapping_the_impacts_of_climate_change

WORLD ATLAS. "Countries of the World." Accessed October 22, 2012. http://www.worldatlas.com/aatlas/populations/ctypopls.htm

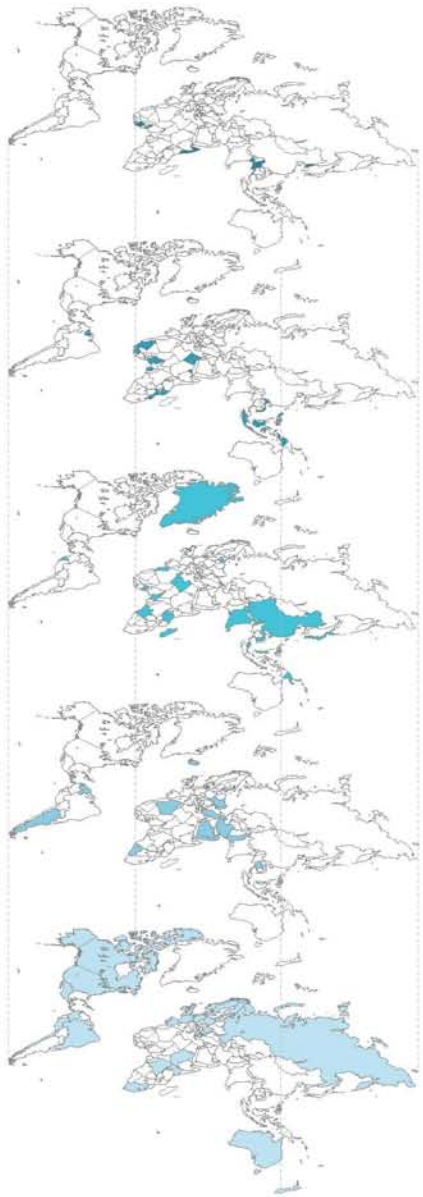
THE WORLD BANK. "Land Area (sq. km.)." Accessed October 22, 2012. http://data.worldbank.org/indicator/AG.LND.TOTL.K2

SEA AROUND US PROJECT. "Exclusive Economic Zones." Accessed October 24, 2012. http://www.seaaroundus.org/eez/





RISK BY POPULATION



20. EXTINCT SPECIES:

FIGURE 43:

The Extinct Species Index ranks countries by the amount of extinct species originated from them.

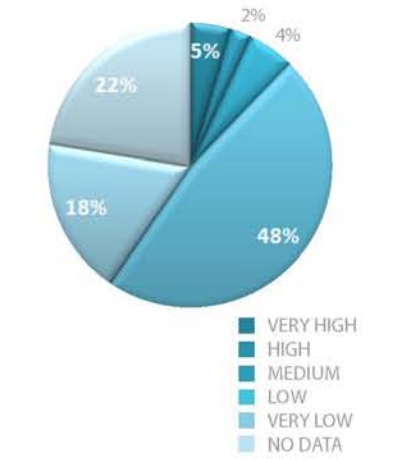
Adapted by author from:

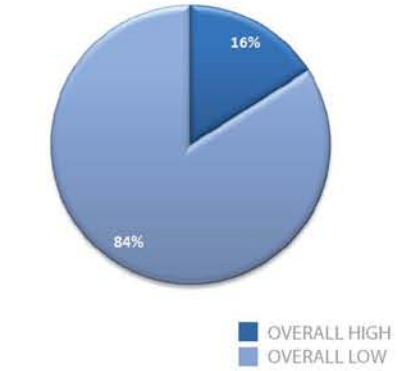
THE GUARDIAN. "Where Species Went Extinct." Last modified September, 2012. http://www.guardian.co.uk/environment/interactive/2012/sep/03/extinct-and-endangered-species-interactive

WORLD ATLAS. "Countries of the World." Accessed October 22, 2012. http://www.worldatlas.com/aatlas/populations/ctypopls.htm

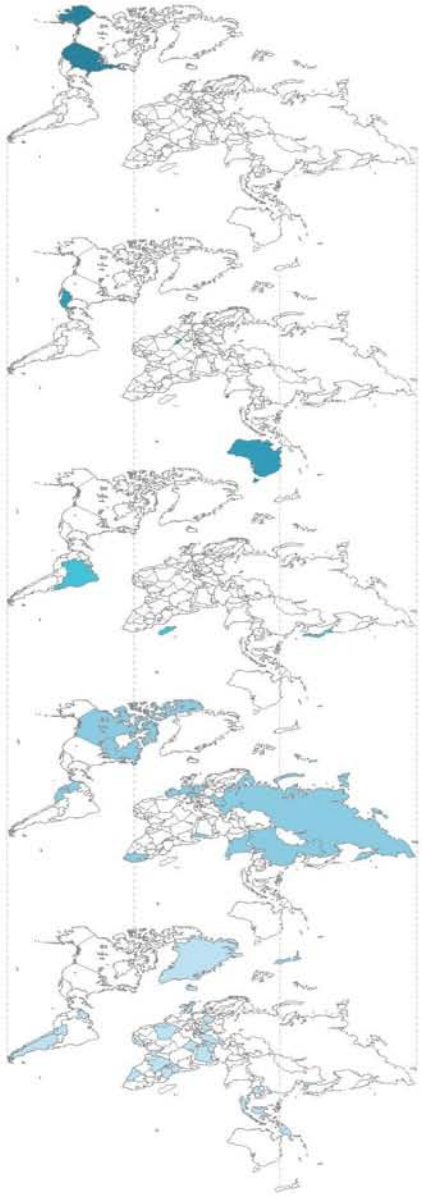
THE WORLD BANK. "Land Area (sq. km.)." Accessed October 22, 2012. http://data.worldbank.org/indicator/AG.LND.TOTL.K2

SEA AROUND US PROJECT. "Exclusive Economic Zones." Accessed October 24, 2012. http://www.seaaroundus.org/eez/





RISK BY POPULATION



FINDING HOME

Risk can affect populations at a variety of scales. It can vary on a person by person basis, regionally, nationally, or even globally. In order to understand how risk operates and which scale is most affected by it, I charted countries in terms of their percentage of world population, percentage of world landmass ownership, and percentage of total ownership when combining landmass and water rights though exclusive economic zones. After the percentages were calculated by country, the maps used in the previous section were used to calculate the highest risks by adding together the countries in the very high and high quantiles for each of the three categories.

FIGURE 44:

Author made image of Fuller's Dymaxion map

(Next Spread) Adapted by author from:

WORLD ATLAS. "Countries of the World." Accessed October 22, 2012. http://www.worldatlas.com/aatlas/populations/ctypopls.htm

THE WORLD BANK. "Land Area (sq. km.)." Accessed October 22, 2012. http://data.worldbank.org/indicator/AG.LND.TOTL.K2

SEA AROUND US PROJECT. "Exclusive Economic Zones." Accessed October 24, 2012. http://www.seaaroundus.org/eez/


JOURNEY TO A SITE
VERY LOW
VERY HIGH

Country	Population	% of World Population	Landmass (sq. km)	% of World Landmass (sq. km)	Exclusive Economic Zone (sq. km)	Water Shelf Ownership Area (sq. km.)	Total Area of Country Ownership (sq. km.)	% of Total Area of Country Ownership
Afghanistan	29,117,000	0.42799%	652,230	0.50520%			652,230	0.21425%
Albania	3,195,000	0.04696%	27,400	0.50520%	11,138	5,903	44,441	0.01460%
Algeria	35,423,000	0.52068%	2,381,740	1.84482%	128,865	9,171	2,519,776	0.82770%
Andorra	84,082	0.00124%	470	0.00036%	----------	----------	470	0.00015%
Angola	18,993,000	0.27918%	1,246,700	0.96565%	501,050	52,869	1,800,619	0.59147%
Antigua & Barbuda	89,000	0.00131%	440	0.00034%	----------	----------	440	0.00014%
Argentina	40,518,951	0.59558%	2,736,690	2.11975%	1,084,386	785,879	4,606,955	1.51331%
Armenia	3,238,000	0.04760%	28,480	0.02206%	----------	----------	28,480	0.00936%
Australia	22,421,417	0.32957%	7,682,300	5.95046%	14,082,870	2,068,132	23,833,302	7.82884%
Austria	8,372,930	0.12307%	82,430	0.06385%	----------	----------	82,430	0.02708%
Azerbaijan	8,997,400	0.13225%	82,620	0.06399%	----------	----------	82,620	0.02714%
Bahamas	346,000	0.00509%	10,010	0.00775%	629,293	108,265	747,568	0.24556%
Bahrain	807,000	0.01186%	760	0.00059%	----------	----------	760	0.00025%
Bangladesh	164,425,000	2.41687%	130,170	0.10083%	78,538	61,731	270,439	0.08883%
Barbados	257,000	0.00378%	----------	0.00000%	----------	----------	----------	----------
Belarus	9,471,900	0.13923%	202,820	0.15710%	----------	----------	202,820	0.06662%
Belgium	10,827,519	0.15915%	30,280	0.02345%	3,453	3,438	37,171	0.01221%
Belize	322,100	0.00473%	22,810	0.01767%	35,995	9,431	68,236	0.02241%
Benin	9,212,000	0.13541%	110,620	0.08568%	30,024	2,852	143,496	0.04714%
Bhutan	708,000	0.01041%	38,390	0.02974%	----------	----------	38,390	0.01261%
Bolivia	10,031,000	0.14744%	1,083,300	0.83909%	----------	----------	1,083,300	0.35585%
Bosnia & Herzegovina	3,760,000	0.05527%	51,000	0.03950%	14	14	51,028	0.01676%
Botswana	1,978,000	0.02907%	566,730	0.43897%	----------	----------	566,730	0.18616%
Brazil	193,364,000	2.84224%	8,459,420	6.55240%	3,648,308	708,816	12,816,544	4.21002%

Country	Population	% of World Population	Landmass (sq. km)	% of World Landmass (sq. km)	Exclusive Economic Zone (sq. km)	Water Shelf Ownership Area (sq. km.)	Total Area of Country Ownership (sq. km.)	% of Total Area of Country Ownership
Brunei	407,000	0.00598%	5,270	0.00408%	25,427	8,633	39,330	0.01292%
Bulgaria	7,576,751	0.11137%	108,560	0.08409%	35,156	11,896	155,612	0.05112%
Burkina Faso	16,287,000	0.23940%	273,600	0.21192%	----------	----------	273,600	0.08987%
Burundi	8,519,000	0.12522%	25,680	0.01989%	----------	----------	25,680.00	0.00844%
Cambodia	13,395,682	0.19690%	176,520	0.13673%	47,827	47,827	272,174	0.08940%
Cameroon	19,958,000	0.29336%	472,710	0.36615%	14,693	10,125	497,528	0.16343%
Canada	34,207,000	0.50281%	9,093,510	7.04354%	6,006,154	2,545,259	17,644,923	5.79606%
Cape Verde	513,000	0.00754%	----------	0.00000%	----------	----------	----------	----------
Central African Republic	4,506,000	0.06623%	622,980	0.48254%	----------	----------	622,980	0.20464%
Chad	11,274,106	0.16572%	1,259,200	0.97534%	----------	----------	1,259,200	0.41363%
Chile	17,114,000	0.25156%	743,530	0.57591%	5,354,679	161,760	6,259,969	2.05630%
China	1,339,190,000	19.68463%	9,327,480	7.22477%	2,290,066	1,016,100	12,633,646	4.14994%
Colombia	45,569,000	0.66981%	1,109,500	0.85938%	817,816	46,316	1,973,632	0.64831%
Comoros	691,000	0.01016%	----------	0.00000%	----------	----------	----------	----------
Congo (Dem. Rep. of)	67,827,000	0.99698%	2,267,050	1.75598%	1,072	756	2,268,878	0.74529%
Congo (Rep.)	3,759,000	0.05525%	341,500	0.26451%	40,499	7,849	389,848	0.12806%
Costa Rica	4,640,000	0.06820%	51,060	0.03955%	572,014	18,600	641,674	0.21078%
Cote d'Ivoire	21,571,000	0.31707%	318,000	0.24631%	174,545	11,824	504,369	0.16568%
Croatia	4,435,056	0.06519%	55,960	0.04334%	56,374	42,019	154,353	0.05070%
Cuba	11,204,000	0.16469%	106,440	0.08245%	365,448	54,888	526,776	0.17304%
Cyprus	801,851	0.01179%	----------	0.00000%	----------	----------	----------	----------
Czech Republic	10,512,397	0.15452%	77,250	0.05984%	----------	----------	77,250	0.02538%
Denmark	5,540,241	0.08144%	42,430	0.03286%	3,001,014	484,074	3,527,518	1.15873%

Country	Population	% of World Population	Landmass (sq. km)	% of World Landmass (sq. km)	Exclusive Economic Zone (sq. km)	Water Shelf Ownership Area (sq. km.)	Total Area of Country Ownership (sq. km.)	% of Total Area of Country Ownership
Djibouti	879,000	0.01292%	----------	0.00000%	----------	----------	----------	----------
Dominica	67,000	0.00098%	750	0.00058%	----------	----------	750	0.00025%
Dominican Republic	10,225,000	0.15030%	48,320	0.03743%	269,285	10,725	328,330	0.10785%
East Timor	1,171,000	0.01721%	----------	0.00000%	----------	----------	----------	----------
Ecuador	14,228,000	0.20914%	248,360	0.19237%	1,908,469	39,503	2,196,332	0.72146%
Egypt	78,848,000	1.15898%	995,450	0.77104%	261,824	47,555	1,304,829	0.42861%
El Salvador	6,194,000	0.09105%	20,720	0.01605%	93,761	18,025	132,506	0.04353%
Equatorial Guinea	693,000	0.01019%	----------	0.00000%	----------	----------	----------	----------
Eritrea	5,224,000	0.07679%	101,000	0.07823%	78,703	56,964	236,667	0.07774%
Estonia	1,340,021	0.01970%	42,390	0.03283%	39,940	35,689	118,019	0.03877%
Ethiopia	79,221,000	1.16446%	1,000,000	0.77457%	----------	----------	1,000,000	0.32848%
Fiji	854,000	0.01255%	18,270	0.01415%	1,281,122	29,926	1,329,318	0.43666%
Finland	5,366,100	0.07888%	303,900	0.23539%	90,828	77,006	471,734	0.15496%
France	65,447,374	0.96200%	547,660	0.42420%	19,290,182	552,773	20,390,615	6.69798%
Gabon	1,501,000	0.02206%	257,670	0.19958%	193,627	36,572	487,869	0.16026%
Gambia	1,751,000	0.02574%	10,000	0.00775%	----------	----------	10,000	0.00328%
Georgia	4,436,000	0.06520%	69,490	0.05382%	22,765	2,467	94,722	0.03111%
Germany	81,757,600	1.20175%	348,610	0.27002%	57,259	55,253	461,122	0.15147%
Ghana	24,333,000	0.35767%	227,540	0.17625%	224,908	22,501	474,949	0.15601%
Greece	11,306,183	0.16619%	128,900	0.09984%	494,605	67,885	691,390	0.22711%
Grenada	104,000	0.00153%	340	0.00026%	----------	----------	340	0.00011%
Guatemala	14,377,000	0.21133%	107,160	0.08300%	117,743	15,707	240,610	0.07904%
Guinea	10,324,000	0.15175%	245,720	0.19033%	109,456	48,122	403,298	0.13248%
Guinea-Bissau	1,647,000	0.02421%	28,120	0.02178%	106,117	35,837	170,074	0.05587%

Country	Population	% of World Population	Landmass (sq. km)	% of World Landmass (sq. km)	Exclusive Economic Zone (sq. km)	Water Shelf Ownership Area (sq. km.)	Total Area of Country Ownership (sq. km.)	% of Total Area of Country Ownership
Guyana	761,000	0.01119%	196,850	0.15247%	135,900	51,978	384,728	0.12638%
Haiti	10,188,000	0.14975%	27,560	0.02135%	135,013	5,126	167,699	0.05509%
Honduras	7,616,000	0.11195%	111,890	0.08667%	240,240	67,366	419,496	0.13780%
Hungary	10,013,628	0.14719%	90,530	0.07012%	----------	----------	90,530	0.02974%
Iceland	317,900	0.00467%	100,250	0.07765%	772,218	109,010	981,478	0.32240%
India	1,184,639,000	17.41290%	2,973,190	2.30294%	2,950,180	441,860	6,365,230	2.09087%
Indonesia	234,181,400	3.44221%	1,811,570	1.40318%	6,079,377	1,810,102	9,701,049	3.18663%
Iran	75,078,000	1.10356%	1,628,550	1.26142%	164,051	108,534	1,901,135	0.62449%
Iraq	31,467,000	0.46253%	434,320	0.33641%	597	362	435,279	0.14298%
Ireland	4,459,300	0.06555%	68,890	0.05336%	410,534	133,534	612,958	0.20135%
Israel	7,602,400	0.11175%	21,640	0.01676%	27,346	3,833	52,819	0.01735%
Italy	60,340,328	0.88694%	294,140	0.22783%	537,932	110,313	942,385	0.30956%
Jamaica	2,730,000	0.04013%	10,830	0.00839%	263,283	13,401	287,514	0.09444%
Japan	127,380,000	1.87235%	364,500	0.28233%	4,469,020	426,940	5,260,460	1.72797%
Jordan	6,472,000	0.09513%	88,780	0.06877%	95	24	88,899	0.02920%
Kazakhstan	16,197,000	0.23808%	2,699,700	2.09110%	----------	----------	2,699,700	0.88681%
Kenya	40,863,000	0.60064%	569,140	0.44084%	111,999	8,874	690,013	0.22666%
Kiribati	100,000	0.00147%	---------	0.00000%	----------	----------	----------	----------
Korea (North)	23,991,000	0.35264%	120,410	0.09327%	115,649	34,769	270,828	0.08896%
Korea (South)	49,773,145	0.73161%	97,100	0.07521%	475,469	292,522	865,091	0.28417%
Kuwait	3,051,000	0.04485%	17,820	0.01380%	12,236	10,651	40,707	0.01337%
Kyrgyzstan	5,550,000	0.08158%	191,800	0.14856%	----------	----------	191,800	0.06300%
Laos	6,436,000	0.09460%	230,800	0.17877%	----------	----------	230,800	0.07581%
Latvia	2,237,800	0.03289%	62,180	0.04816%	32,021	27,990	122,191	0.04014%
Lebanon	4,255,000	0.06254%	10,230	0.00792%	19,196	1,021	30,447	0.01000%

Country	Population	% of World Population	Landmass (sq. km)	% of World Landmass (sq. km)	Exclusive Economic Zone (sq. km)	Water Shelf Ownership Area (sq. km.)	Total Area of Country Ownership (sq. km.)	% of Total Area of Country Ownership
Lesotho	2,084,000	0.03063%	30,360	0.02352%	----------	----------	30,360	0.00997%
Liberia	3,476,608	0.05110%	96,320	0.07461%	246,152	17,962	360,434	0.11840%
Libya	6,546,000	0.09622%	1,759,540	1.36288%	355,120	64,894	2,179,554	0.71595%
Liechtenstein	35,904	0.00053%	----------	0.00000%	----------	----------	----------	----------
Lithuania	3,329,227	0.04894%	62,670	0.04854%	6,104	5,871	74,645	0.02452%
Luxembourg	502,207	0.00738%	2,590	0.00201%	----------	----------	2,590	0.00085%
Macedonia	2,048,620	0.03011%	25,220	0.01953%	----------	----------	25,220	0.00828%
Madagascar	21,146,000	0.31082%	581,540	0.45044%	1,198,722	124,551	1,904,813	0.62570%
Malawi	15,692,000	0.23066%	94,280	0.07303%	----------	----------	94,280	0.03097%
Malaysia	28,306,700	0.41608%	328,550	0.25448%	447,276	386,178	1,162,004	0.38170%
Maldives	314,000	0.00462%	----------	0.00000%	----------	----------	----------	
Mali	14,517,176	0.21339%	1,220,190	0.94512%	----------	----------	1,220,190	0.40081%
Malta	416,333	0.00612%	----------	0.00000%	----------	----------	----------	----------
Marshall Islands	63,000	0.00093%	----------	0.00000%	----------	----------	----------	----------
Mauritania	3,366,000	0.04948%	1,030,700	0.79835%	155,422	28,341	1,214,463	0.39893%
Mauritius	1,297,000	0.01906%	2,030	0.00157%	----------	----------	2,030	0.00067%
Mexico	108,396,211	1.59331%	1,943,950	1.50572%	3,269,386	402,064	5,615,400	1.84457%
Micronesia	111,000	0.00163%	700	0.00054%	----------	----------	700	0.00023%
Moldova	3,563,800	0.05238%	32,890	0.02548%	----------	----------	32,890	0.01080%
Monaco	33,000	0.00049%	----------	0.00000%	----------	----------		----------
Mongolia	2,768,800	0.04070%	1,553,560	1.20334%	----------	----------	1,553,560	0.51032%
Morocco	31,892,000	0.46878%	446,300	0.34569%	572,712	113,330	1,132,342	0.37196%
Mozambique	23,406,000	0.34404%	786,380	0.60910%	924,072	81,890	1,792,342	0.58875%
Myanmar	50,496,000	0.74224%	653,520	0.50620%	520,262	208,705	1,382,487	0.45412%

Country	Population	% of World Population	Landmass (sq. km)	% of World Landmass (sq. km)	Exclusive Economic Zone (sq. km)	Water Shelf Ownership Area (sq. km.)	Total Area of Country Ownership (sq. km.)	% of Total Area of Country Ownership
Namibia	2,212,000	0.03251%	823,290	0.63769%	560,152	93,695	1,477,137	0.48521%
Nauru	10,000	0.00015%	----------	----------	----------	----------	----------	----------
Nepal	29,853,000	0.43881%	143,350	0.11103%	----------	----------	143,350	0.04709%
Netherlands	16,609,518	0.24414%	33,730	0.02613%	144,864	66,658	245,252.00	0.08056%
New Zealand	4,383,600	0.06443%	263,310	0.20395%	9,971,625	260,349	10,495,284	3.44753%
Nicaragua	5,822,000	0.08558%	120,340	0.09321%	127,488	73,114	320,942	0.10542%
Niger	15,891,000	0.23358%	1,266,700	0.98115%	----------	----------	1,266,700	0.41609%
Nigeria	158,259,000	2.32623%	910,770	0.70545%	216,789	39,644	1,167,203	0.38341%
Norway	4,896,700	0.07198%	305,470	0.23661%	3,289,332	447,232	4,042,034	1.32774%
Oman	2,905,000	0.04270%	309,500	0.23973%	535,912	54,206	899,618	0.29551%
Pakistan	170,260,000	2.50264%	770,880	0.59710%	221,435	47,343	1,039,658	0.34151%
Palau	20,000	0.00029%	----------	0.00000%	----------	----------	----------	----------
Panama	3,322,576	0.04884%	74,340	0.05758%	331,465	48,976	454,781	0.14939%
Papua New Guinea	6,888,000	0.10125%	452,860	0.35077%	2,396,214	177,864	3,026,938	0.99430%
Paraguay	6,460,000	0.09495%	397,300	0.30774%	----------	----------	397,300	0.13051%
Peru	29,461,933	0.43306%	1,280,000	0.99145%	906,454	79,198	2,265,652	0.74423%
Philippines	94,013,200	1.38189%	298,170	0.23095%	2,265,684	251,653	2,815,507	0.92485%
Poland	38,167,329	0.56102%	304,200	0.23562%	31,600	31,160	366,960	0.12054%
Portugal	10,636,888	0.15635%	91,470	0.07085%	3,343,499	27,841	3,462,810	1.13748%
Qatar	1,696,563	0.02494%	11,590	0.00898%	31,870	30,176	73,636	0.02419%
Romania	21,466,174	0.31553%	230,060	0.17820%	20,598	16,852	267,510	0.08787%
Russia	141,927,297	2.08618%	16,376,870	12.68500%	8,095,881	4,099,812	28,572,563	9.38561%
Rwanda	10,277,000	0.15106%	24,670	0.01911%	----------	----------	24,670	0.00810%
Saint Kitts & Nevis	38,960	0.00057%	----------	----------	----------	----------	----------	----------

Country	Population	% of World Population	Landmass (sq. km)	% of World Landmass (sq. km)	Exclusive Economic Zone (sq. km)	Water Shelf Ownership Area (sq. km.)	Total Area of Country Ownership (sq. km.)	% of Total Area of Country Ownership
Saint Lucia	174,000	0.00256%	----------	----------	----------	----------	----------	----------
Samoa	179,000	0.00263%	----------	----------	----------	----------	----------	----------
San Marino	32,386	0.00048%	----------	----------	----------	----------	----------	----------
Sao Tome & Principe	165,000	0.00243%	----------	----------	----------	----------	----------	----------
Saudi Arabia	26,246,000	0.38579%	2,149,690	1.66508%	219,905	88,946	2,458,541	0.80759%
Senegal	12,861,000	0.18904%	192,530	0.14913%	157,550	21,835	371,915	0.12217%
Serbia & Montenegro	9,856,000	0.14487%	87,460	0.06774%	----------	----------	87,460	0.02873%
Seychelles	85,000	0.00125%	----------	----------	----------	----------	----------	----------
Sierra Leone	5,836,000	0.08578%	71,620	0.05547%	159,744	26,934	258,298	0.08485%
Singapore	4,987,600	0.07331%	----------	----------	----------	----------	----------	----------
Slovakia	5,426,645	0.07977%	48,090	0.03725%	----------	----------	48,090	0.01580%
Slovenia	2,062,700	0.03032%	20,140	0.01560%	186	158	20,484	0.00673%
Solomon Islands	536,000	0.00788%	27,990	0.02168%	1,597,492	32,759	1,658,241	0.54470%
Somalia	9,359,000	0.13757%	627,340	0.48592%	830,389	47,511	1,505,240	0.49445%
South Africa	49,991,300	0.73482%	1,214,470	0.94069%	2,013,415	160,651	3,388,536	1.11308%
South Sudan	8,260,490	0.12142%	----------	----------	----------	----------	----------	
Spain	46,951,532	0.69014%	498,800	0.38635%	1,007,271	72,471	1,578,542	0.51852%
Sri Lanka	20,410,000	0.30000%	62,710	0.04857%	530,684	29,885	623,279	0.20474%
St. Vincent & the Grenadines	109,000	0.00160%	----------	----------	----------	----------	----------	----------
Sudan	31,894,000	0.46881%	2,376,000	1.84037%	88,067	13,047	2,477,114	0.81369%
Suriname	524,000	0.00770%	156,000	0.12083%	128,318	55,700	340,018	0.11169%
Swaziland	1,202,000	0.01767%	17,200	0.01332%	----------	----------	17,200	0.00565%
Sweden	9,366,092	0.13767%	410,340	0.31784%	170,086	149,848	730,274	0.23988%

Country	Population	% of World Population	Landmass (sq. km)	% of World Landmass (sq. km)	Exclusive Economic Zone (sq. km)	Water Shelf Ownership Area (sq. km.)	Total Area of Country Ownership (sq. km.)	% of Total Area of Country Ownership
Switzerland	7,782,900	0.11440%	40,000	0.03098%	----------	----------	40,000	0.01314%
Syria	22,505,000	0.33080%	183,630	0.14223%	10,222	969	194,821	0.06400%
Tajikistan	7,075,000	0.10399%	139,960	0.10841%	----------	----------	139,960	0.04597%
Tanzania	45,040,000	0.66204%	885,800	0.68611%	241,541	16,929	1,144,270	0.37587%
Thailand	63,525,062	0.93375%	510,890	0.39572%	306,365	232,634	1,049,889	0.34487%
Togo	6,780,000	0.09966%	54,390	0.04213%	15,375	1,048	70,813	0.02326%
Tonga	104,000	0.00153%	----------	0.00000%	----------	----------	----------	----------
Trinidad & Tobago	1,344,000	0.01976%	----------	----------	----------	----------	----------	----------
Tunisia	10,432,500	0.15335%	155,360	0.12034%	102,362	66,322	324,044	0.10644%
Turkey	72,561,312	1.06657%	769,630	0.59613%	255,787	46,698	1,072,115	0.35217%
Turkmenistan	5,177,000	0.07610%	469,930	0.36399%	----------	----------	469,930	0.15436%
Tuvalu	10,000	0.00015%	----------	----------	----------	----------	----------	----------
Uganda	33,796,000	0.49676%	199,810	0.15477%	----------	----------	199,810	0.06563%
Ukraine	45,871,738	0.67426%	579,320	0.44872%	144,038	78,552	801,910	0.26341%
United Arab Emirates	4,707,000	0.06919%	83,600	0.06475%	57,194	51,080	191,874	0.06303%
United Kingdom (UK)	62,041,708	0.91195%	241,930	0.18739%	6,651,092	762,065	7,655,087	2.51457%
United States of America	309,975,000	4.55629%	9,147,420	7.08530%	11,389,027	2,074,770	22,611,217	7.42741%
Uruguay	3,372,000	0.04956%	175,020	0.13556%	132,286	63,854	371,160	0.12192%
Uzbekistan	27,794,000	0.40854%	425,400	0.32950%			425,400	0.13974%
Vanuatu	246,000	0.00362%	12,190	0.00944%	827,891	7,744	847,825	0.27850%
Vatican City	800	0.00001%	----------	---------	----------	----------	----------	
Venezuela	28,888,000	0.42462%	882,050	0.00000%	471,507	99,889	1,453,446	0.47743%
Vietnam	85,789,573	1.26101%	310,070	0.24017%	1,396,299	424,969	2,131,338	0.70011%
Yemen	24,256,000	0.35654%	527,970	0.40895%	544,416	59,021	1,131,407	0.37165%
Zambia	13,257,000	0.19486%	743,390	0.57581%	----------	----------	743,390	0.24419%
Zimbabwe	12,644,000	0.18585%	386,850	0.29964%	----------	----------	386,850	0.12707%
	6,803,227,224	100.00%	129,104,230	100.00%	150,264,267	25,060,995	304,429,492	100.00000%

PERCENTAGE OF POPULATION

By author

Risk Factor by Population	Very Low	Low	Medium	High	Very High
Ecological Footprint	0.16951%	4.75273%	7.50044%	73.04617%	13.26954%
Fossil Fuel Dependency	14.60616%	1.99655%	7.25982%	60.73477%	13.75347%
Extreme Weather	12.66006%	13.40237%	11.93485%	13.13521%	48.60971%
Endangered Species	1.47582%	20.38459%	21.04352%	47.02801%	6.77481%
Non-Communicable Disease	6.97442%	9.74965%	31.39176%	42.10157%	8.10972%
Water Scarcity	----------	20.31431%	32.03677%	46.23172%	----------
Lack of Coping Capabilities	13.82894%	11.84197%	28.82014%	29.07707%	14.60730%
Lack of Adaptation	15.09578%	12.81455%	27.67482%	29.16767%	13.45687%
Susceptibility	9.77393%	14.57113%	29.09308%	31.49369%	10.23480%
Vulnerability	14.12947%	11.85062%	29.97524%	26.65201%	14.76563%
Communicable Disease	----------	25.08617%	30.81591%	28.72379%	12.26115%
Food Deprivation	19.00577%	8.11629%	35.53453%	28.30685	8.27796%
Terrorism	----------	29.45637%	30.51267%	6.73869%	31.97571%
Agricultural Productivity Loss	40.62549%	15.88472%	10.74359%	27.49111%	4.59808%
Political/Economical	13.62430%	8.83505%	45.92009%	16.26596%	14.73527%
Insecurity	9.09701%	16.53358%	45.24743%	15.26386%	11.61355%
Population Growth	11.18200%	27.21334%	31.85127%	15.86336%	10.40337%
Exposure	11.28196%	9.55473%	54.97399%	10.27024%	12.15006%
Sea Level Rise	23.25968%	9.47910%	43.30040%	10.73792%	4.61220%
Extinct Species	17.94530%	47.48863%	5.19010%	2.37623%	4.55629%

PERCENTAGE OF LANDMASS

By author

Risk Factor by Landmass Area	Very Low	Low	Medium	High	Very High
Ecological Footprint	1.03867%	25.13688%	24.61732%	34.25724%	12.40270%
Fossil Fuel Dependency	27.63649%	9.21918%	4.27928%	40.93754%	15.25270%
Extreme Weather	12.46299%	34.50147%	23.56689%	10.96560%	18.29182%
Endangered Species	3.54608%	35.23192%	31.60367%	19.82514%	9.03788%
Non-Communicable Disease	15.49892%	10.82899%	22.94820%	24.01710%	24.78452%
Water Scarcity	----------	35.59569%	41.47944%	20.04535%	----------
Lack of Coping Capabilities	23.62267%	31.37123%	18.11650%	12.23352%	12.01449%
Lack of Adaptation	26.00325%	27.41254%	19.73221%	12.22948%	12.33984%
Susceptibility	16.43388%	31.40767%	18.36034%	11.53315%	12.99233%
Vulnerability	23.48870%	30.20724%	20.03437%	9.66674%	13.51633%
Communicable Disease	----------	29.54104%	29.26140%	10.39988%	17.77398%
Food Deprivation	27.17671%	26.38122%	24.57931%	10.59156%	10.81937%
Terrorism	----------	50.52518%	15.31363%	6.26354%	26.69816%
Agricultural Productivity Loss	50.68188%	20.09566%	9.97654%	11.83724%	6.80719%
Political/Economical	23.79046%	12.63474%	31.88991%	13.79802%	17.45656%
Insecurity	25.08655%	31.70719%	17.16011%	14.25135%	7.44569%
Population Growth	7.68283%	30.30307%	15.95769%	17.85392%	14.62569%
Exposure	37.56744%	8.96174%	27.57450%	17.23087%	6.07379%
Sea Level Rise	51.79468%	10.73061%	16.20245%	6.02803%	1.75487%
Extinct Species	17.66177%	34.97698%	7.36761%	7.62509%	7.08530%

PERCENTAGE OF TOTAL OWNERSHIP

By author

Risk Factor by Total Area (Landmass, Exclusive Economic Zone, and Water Shelf Combined)	Very Low	Low	Medium	High	Very High
Ecological Footprint	0.51610%	24.53147%	19.82706%	34.59993%	17.78369%
Fossil Fuel Dependency	21.29583%	5.97618%	6.92980%	41.56824%	21.39590%
Extreme Weather	20.06433%	36.44978%	18.06083%	12.20022%	13.21975%
Endangered Species	1.55233%	27.31891%	43.46768%	16.72301%	10.37513%
Non-Communicable Disease	27.87710%	18.23342%	15.82703%	19.17927%	15.75986%
Water Scarcity	----------	43.57414%	39.86190%	12.51141%	----------
Lack of Coping Capabilities	41.61154%	22.60950%	13.82904%	13.77851%	6.76199%
Lack of Adaptation	43.46786%	23.78915%	12.20504%	11.85866%	7.82792%
Susceptibility	33.18358%	25.90453%	16.15229%	11.24301%	7.82101%
Vulnerability	41.69063%	23.25878%	14.12437%	10.93125%	8.29433%
Communicable Disease	----------	49.47431%	20.94574%	8.29433%	10.33712%
Food Deprivation	26.63051%	26.73749%	19.33986%	10.30535%	6.43980%
Terrorism	----------	55.31977%	20.08357%	3.70836%	18.55856%
Agricultural Productivity Loss	60.54159%	17.75903%	9.67383%	7.43585%	3.96574%
Political/Economical Insecurity	42.85555%	10.69641%	21.77298%	12.46020%	10.59330%
Population Growth	27.64586%	34.03677%	13.68022%	11.66042%	10.57275%
Exposure	18.92592%	30.94873%	17.84794%	12.42393%	8.63345%
Sea Level Rise	33.66508%	9.79786%	21.51671%	20.25985%	12.16686%
Extinct Species	60.54517%	8.66659%	15.00311%	7.71863%	2.04897%
	19.86659%	38.43888%	6.73673%	9.98459%	7.42741%

HOME BASE

I examined the top ten most frequent countries in both the very high and very low quantiles in order to determine the most suitable location for a site. Because the project is conceived as an aid to help the segment of the world's population facing the highest risk, deciding on a single site was difficult. If the project were to be located in a country with very high risk associated with it, it would be hard to create a feasible project. If, for example, the project were to be located in Afghanistan, the most frequently high risk country, many of its political issues would interfere with helping the rest of the world population. In the end, I decided that the building testing facility should be placed in a country with very low risk associated with it in order to protect the building, but that it would still work to benefit those in very high risk countries. Sweden and Norway tied for having the least risk associated with them, so a site in one of these two countries will be chosen for the project. In addition to being responsive to risk, the project also needs to be located within an area that will be able to support it. The site requires access to transportation systems such as waterways, rail lines, airports, and major highways. Additionally, the program demands a large workforce and to be in close vicinity to research universities and hospitals to perform the tests. Because of this, Oslo, Norway and Stockholm, Sweden will be looked into further in order to locate a site next semester.

FIGURE 45:

Author made image of Fuller's Dymaxion map


THE SITES
VERY LOW
VERY HIGH

MOST FREQUENT IN VERY LOW RISK QUANTILE

Risk Factor	Norway	Sweden	Finland	Canada	France	Spain	Greece	Belgium	Denmark	Germany
Ecological Footprint										
Fossil Fuel Dependency	✓	✓		✓						
Extreme Weather	✓	✓	✓		✓	✓	✓	✓	✓	✓
Endangered Species										
Non-Communicable Disease	✓	✓		✓	✓	✓	✓			
Water Scarcity	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Lack of Coping Capabilities	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Lack of Adaptation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Susceptibility	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Vulnerability	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Communicable Disease	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Food Deprivation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Terrorism	✓	✓	✓	✓		✓		✓	✓	✓
Agricultural Productivity Loss	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Political/Economical	✓	✓	✓	✓	✓	✓		✓	✓	✓
Insecurity	✓	✓	✓	✓	✓	✓		✓	✓	✓
Population Growth	✓	✓	✓		✓	✓	✓	✓	✓	✓
Exposure	✓	✓	✓	✓	✓					
Sea Level Rise	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Extinct Species							✓			

MOST FREQUENT IN VERY HIGH RISK QUANTILE

Risk Factor	Afghanistan	Ethiopia	Niger	Bangladesh	Central African Republic	Sudan	Eritrea	Chad	Madagascar	Mozambique
Ecological Footprint										
Fossil Fuel Dependency				✓			✓			
Extreme Weather		✓	✓	✓		✓	✓		✓	✓
Endangered Species										
Non-Communicable Disease	✓	✓			✓			✓		✓
Water Scarcity	✓									
Lack of Coping Capabilities	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Lack of Adaptation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Susceptibility	✓	✓	✓		✓	✓	✓	✓	✓	✓
Vulnerability	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Communicable Disease		✓	✓		✓	✓	✓	✓	✓	✓
Food Deprivation	✓	✓	✓	✓	✓		✓	✓	✓	✓
Terrorism	✓				✓	✓				
Agricultural Productivity Loss	✓	✓			✓	✓				
Political/Economical	✓					✓				
Insecurity	✓		✓	✓				✓		
Population Growth	✓	✓	✓				✓		✓	
Exposure	✓		✓	✓						
Sea Level Rise				✓						
Extinct Species										

THE BOARDS

In order to understand the possible equipment to be used in the building testing facility, information on the machinery was gathered and modeled. The image shows all the equipment at the same scale in order to better understand the relationships between geometry, function, and construction techniques.

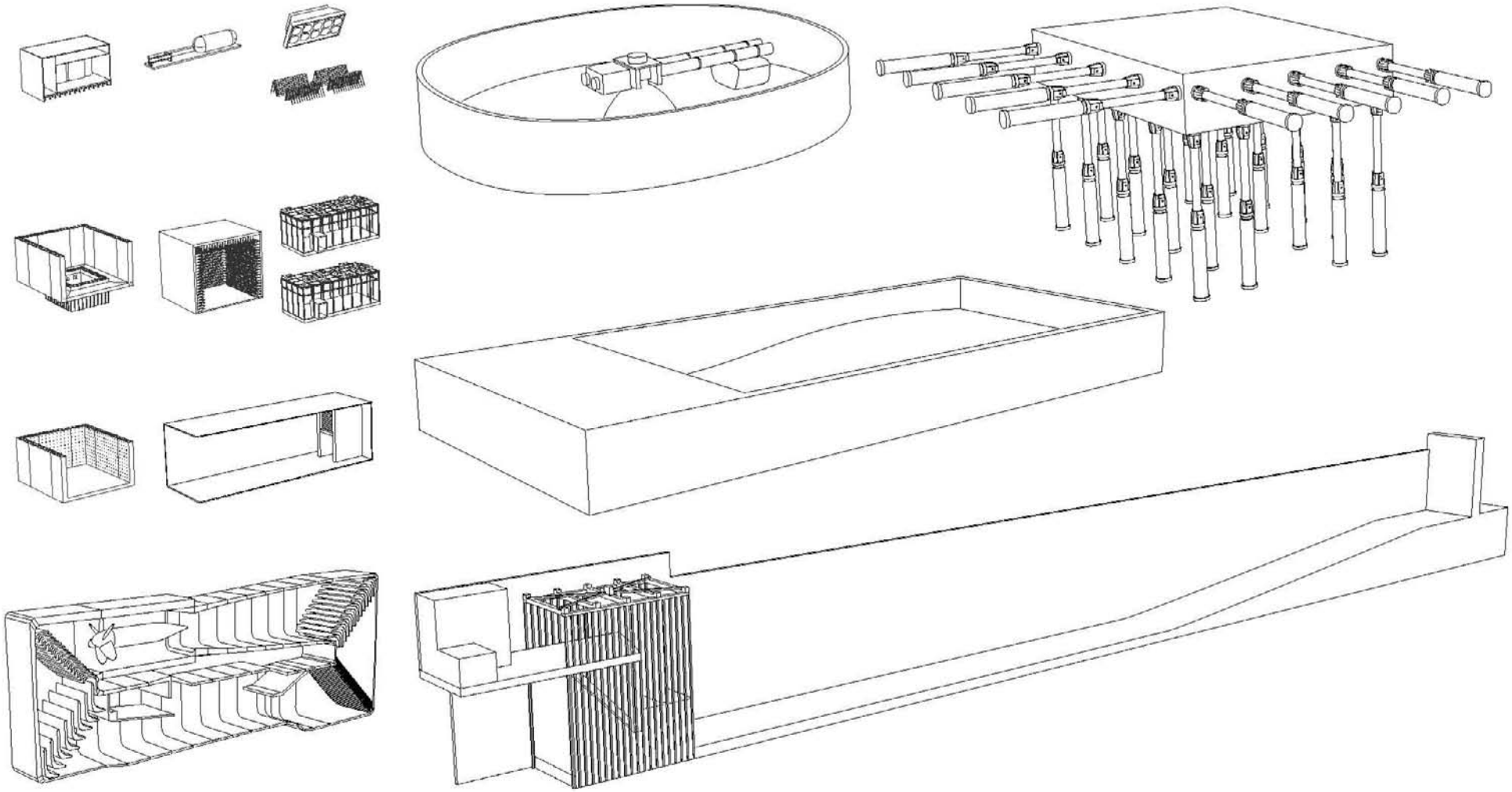
The next section will address each piece of equipment in depth through the labs they belong to, including:

Structural engineering, wind tunnel, electromagnetic,fire resistance, chemical substance control, centrifuge, biological clean room, horticulture, insect control, earthquake, solar, extreme temperature, tsunami and flooding, and missile impact testing facilities.

In the WorldGame, these machines and facilities act as the board game, creating the base for players to interact with. In the end, these machines will combine to create the ultimate in interaction through the creation of a game stadium where all game pieces can be tested at once.

FIGURE 46:

Author made image



STRUCTURAL ENGINEERING LABORATORY

This facility is used for evaluating the structural performance of building members such as columns, beams, walls and slabs, as well as claddings; it features a 20 MN static load testing machine and large reaction walls and floors. Large scale tests can be performed in this laboratory. [46]

Materials: Reinforced Concrete

Dimensions: 30' x 25' x 15'

Geometry Dependent: No

Base Imagery: Takenaka Research and Development Institute, Osaka, Japan and the Indian Institute of Technology, Guwahati, India

Risks: Exposure, Insecurity, Terrorism, Vulnerability, Susceptibility, Extreme Weather

Images From:

[46] TAKENAKA CORPORATION. "Takenaka Research and Development Institute Facility Overview." Accessed November 26, 2012. http://www.takenaka.co.jp/takenaka_e/company/r&d_e/rd_b.html

DEPARTMENT OF CIVIL ENGINEERING, INDIAN INSTITUTE OF TECHNOLOGY. "Structural Engineering Laboratory." Accessed November 26, 2012. http://www.iitg.ac.in/civil/photo_1.html

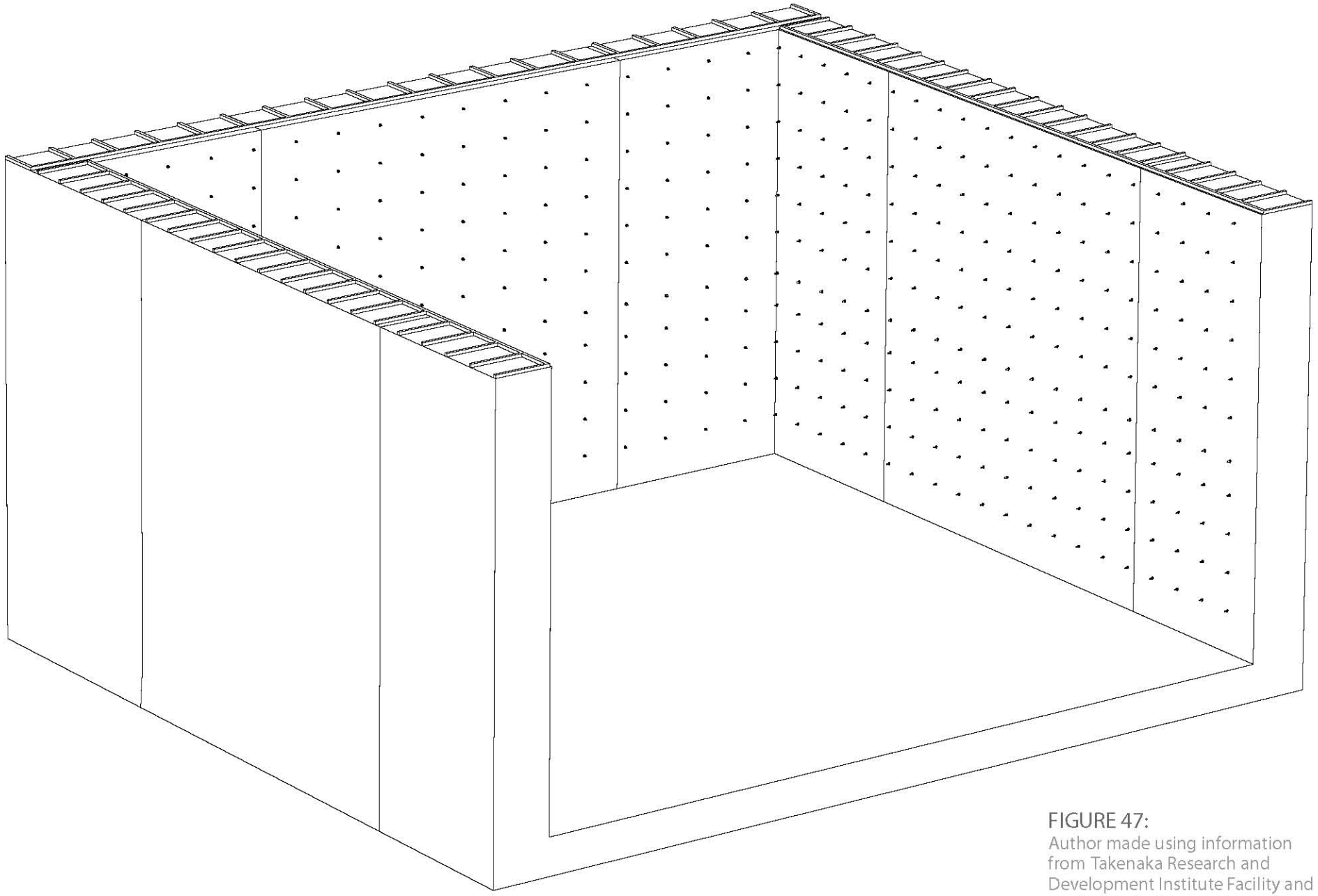
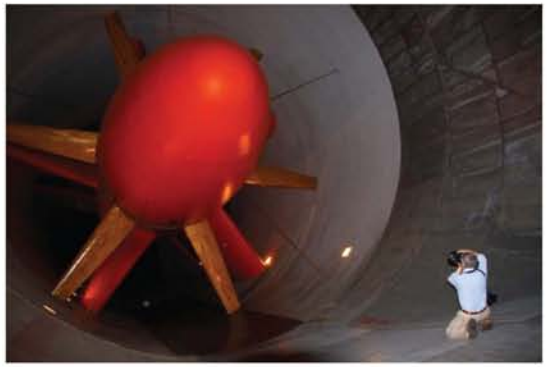


FIGURE 47:
Author made using information from Takenaka Research and Development Institute Facility and the Indian Institute of Technology

WIND TUNNEL TESTING ROOM



Super high-rise and very large-scale structural designs must take account of wind. The wind tunnel laboratory incorporates equipment with maximum wind speeds of 40 m/s and 20 m/s to ensure accurate wind-resistant designs and wind environment measures. [47]

Materials: Aluminum

Dimensions: 170' x 20' x 60'

Geometry Dependent: Yes

Base Imagery: Takenaka Research and Development Institute, Osaka, Japan and General Motors, Warren, Michigan

Risks: Exposure, Insecurity, Communicable Disease, Lack of Adaptation, Extreme Weather, Fossil Fuel Dependency, Ecological Footprint

Images From:

[47] TAKENAKA CORPORATION. "Takenaka Research and Development Institute Facility Overview." Accessed November 26, 2012. http://www.takenaka.co.jp/takenaka_e/company/r&d_e/rd_b.html

AUTOBLOG. "General Motors' Wind Tunnel." Last Modified August 5, 2010. http://green.autoblog.com/2010/08/05/gms-wind-tunnel-turns-30/

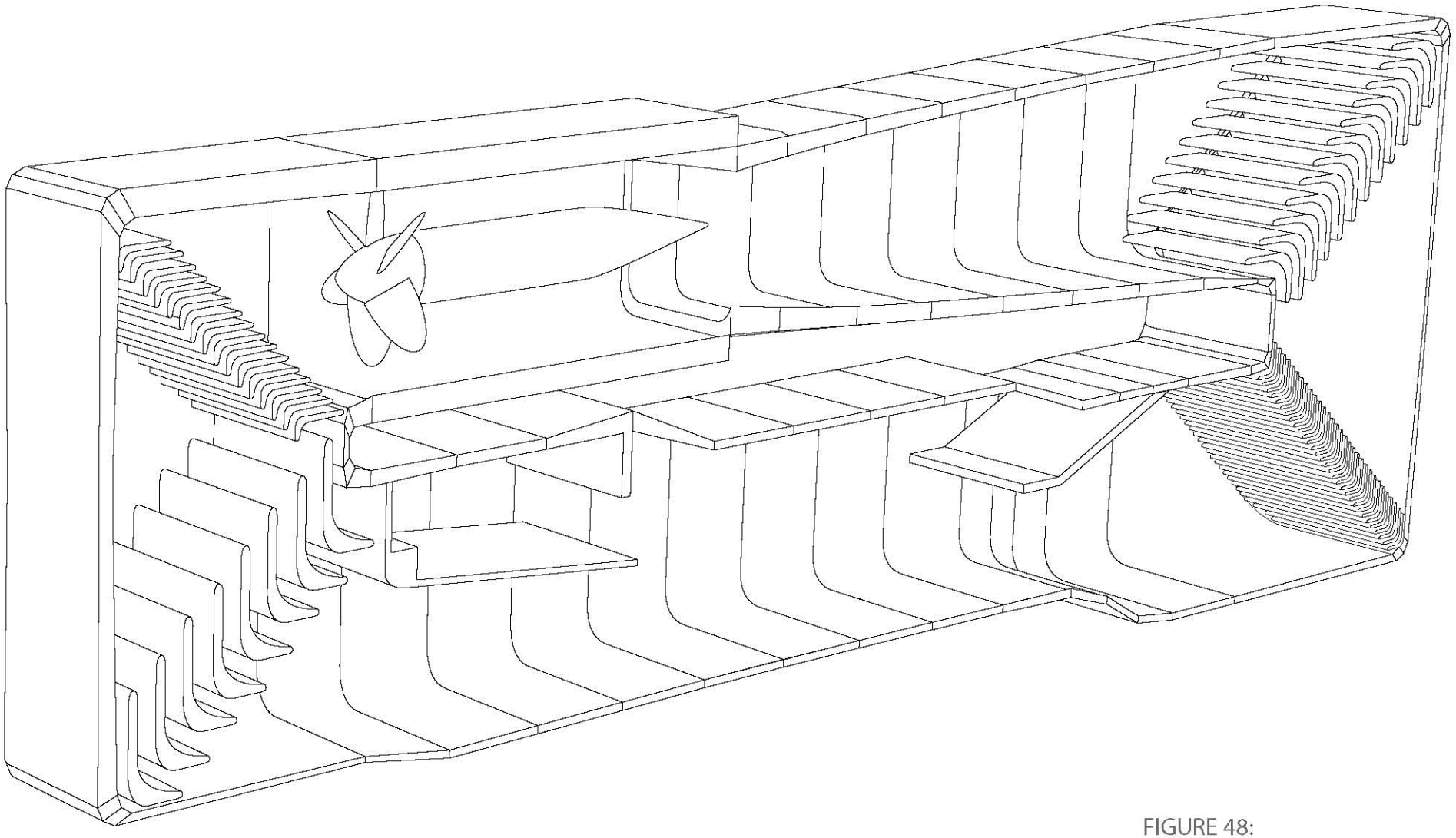


FIGURE 48:
Author made using information from Takenaka Research and Development Institute Facility and General Motors

ELECTROMAGNETIC TESTING ROOM

This facility conducts various electromagnetic measurements and assessments. It comprises an electromagnetic shield chamber, an anechoic chamber, and a control room. The room can be used to develop new materials and structural members to control EM effects inside and outside buildings and better electromagnetic environments.[48]

Materials: Reinforced Concrete, Ferrite

Dimensions: 25' x 25' x 25'

Geometry Dependent: Yes

Base Imagery: Takenaka Research and Development Institute, Osaka, Japan and Ministry of Defense, United Kingdom

Risks: Exposure, Susceptibility, Lack of Adaptation

Images From:

[48] TAKENAKA CORPORATION. "Takenaka Research and Development Institute Facility Overview." Accessed November 26, 2012. http://www.takenaka.co.jp/takenaka_e/company/r&d_e/rd_b.html

AMIDEON. "Anechoic Chamber." Accessed November 26, 2012. http://amideon.net/emc-systems/anechoic-chambers/

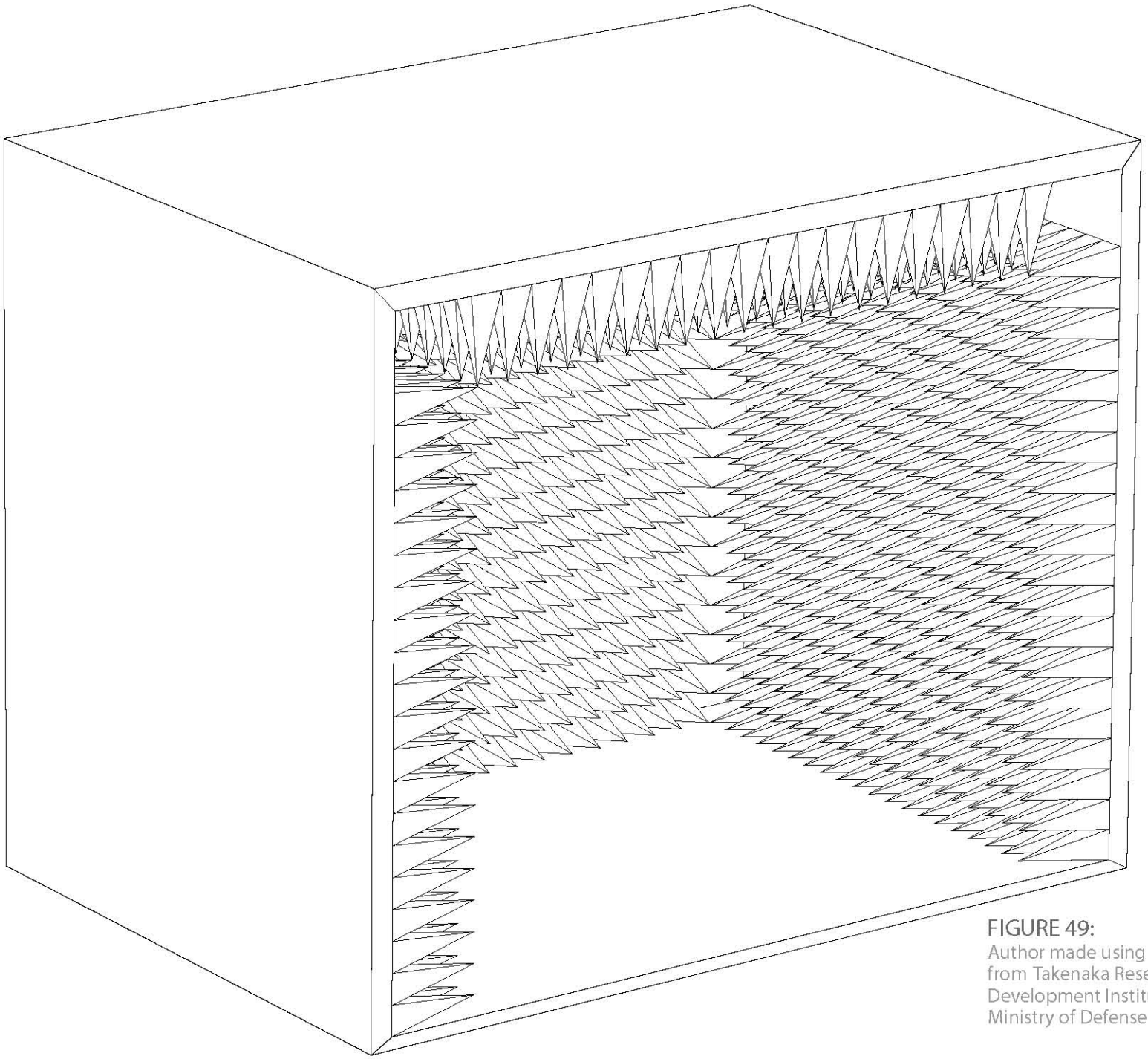


FIGURE 49:
Author made using information from Takenaka Research and Development Institute Facility and Ministry of Defense (U.K.)

FIRE-RESISTANT LABORATORY

This is the largest facility of its kind, with a load capacity of 30 MN, and the ability to withstand continuous heating continuously for 8 hours. It allows scientists to verify the fire resistance of nearly full-scale components, even structural members (with a compression strength of around 200 N/mm2) for 50-floor buildings. Ever more accurate performance confirmation tests for fire-resistant designs and the development of high-strength materials for ultrahigh-rise buildings help ensure the safety of the increasingly diverse structural designs characteristic of modern architecture.[49]

Materials: Reinforced Concrete, Steel

Dimensions: 25'x 30'x 20'

Geometry Dependent: No

Base Imagery: Takenaka Research and Development Institute, Osaka, Japan

Risks: Exposure, Insecurity, Agricultural Productivity Loss, Vulnerability, Susceptibility, Lack of Adaptation, Lack of Coping Capabilities, Extreme Weather

Images From:

[49] TAKENAKA CORPORATION. "Takenaka Research and Development Institute Facility Overview." Accessed November 26, 2012. http://www.takenaka.co.jp/takenaka_e/company/r&d_e/rd_b.html

FIRE TESTING TECHNOLOGY. "Horizontal Fire Resistance Test Furnace." Accessed November 26, 2011. http://www.fire-testing.com/horizontal-test

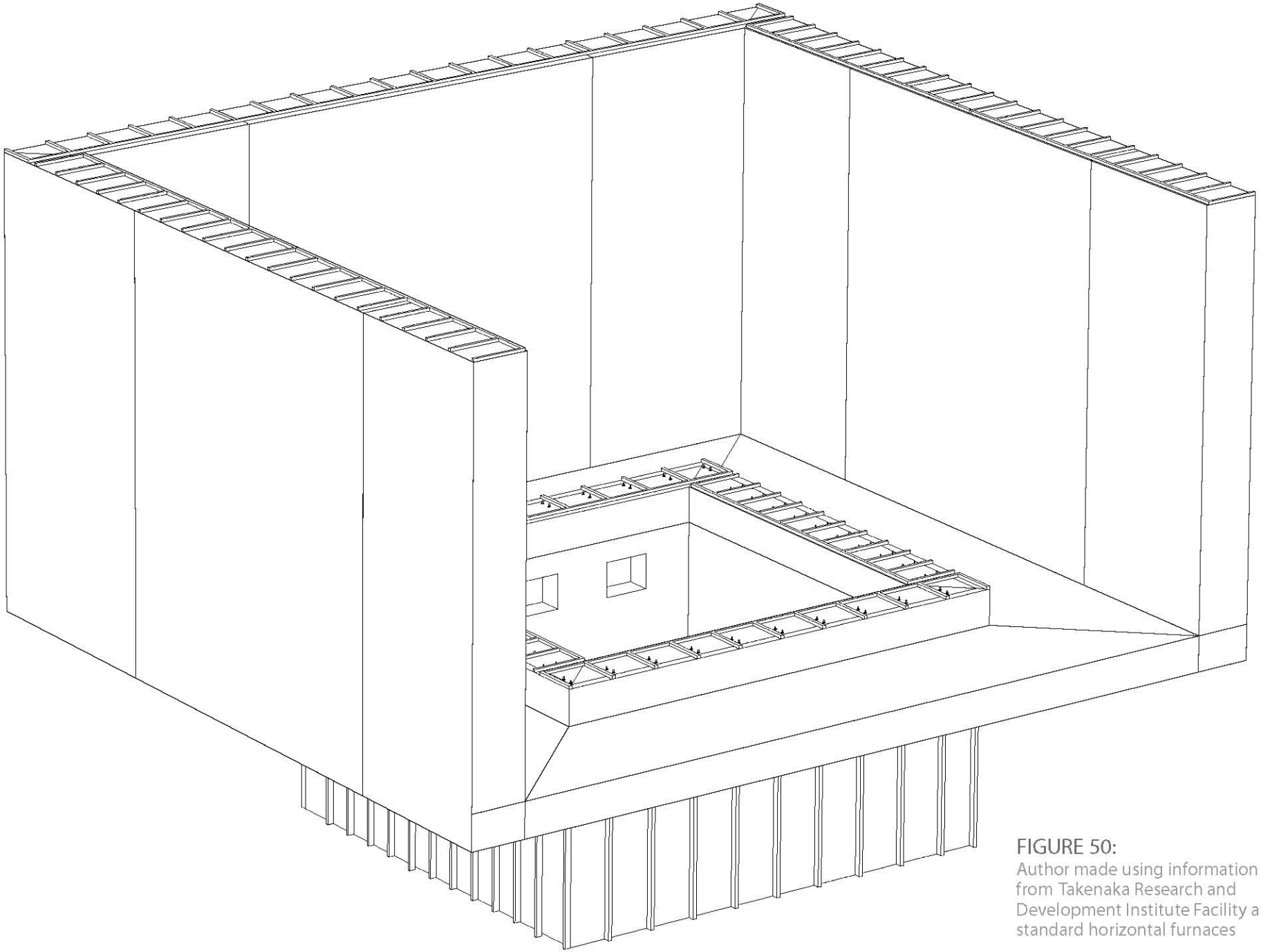


FIGURE 50:
Author made using information from Takenaka Research and Development Institute Facility and standard horizontal furnaces

CHEMICAL SUBSTANCE CONTROL LABORATORY

Furniture or office equipment can contain volatile organic compounds (VOCs) thought to be the cause of sick building syndrome and other problems. This laboratory is used to evaluate VOC emission levels and to develop new interior materials and air-conditioning systems that eliminate such hazardous substances.[50]

Materials: Aluminum

Dimensions: 28'x 16'x 16'

Geometry Dependent: No

Base Imagery: Takenaka Research and Development Institute, Osaka, Japan

Risks: Exposure, Insecurity, Vulnerability, Lack of Adaptation, Lack of Coping Capabilities

Images From:

[50] TAKENAKA CORPORATION. "Takenaka Research and Development Institute Facility Overview." Accessed November 26, 2012. http://www.takenaka.co.jp/takenaka_e/company/r&d_e/rd_b.html

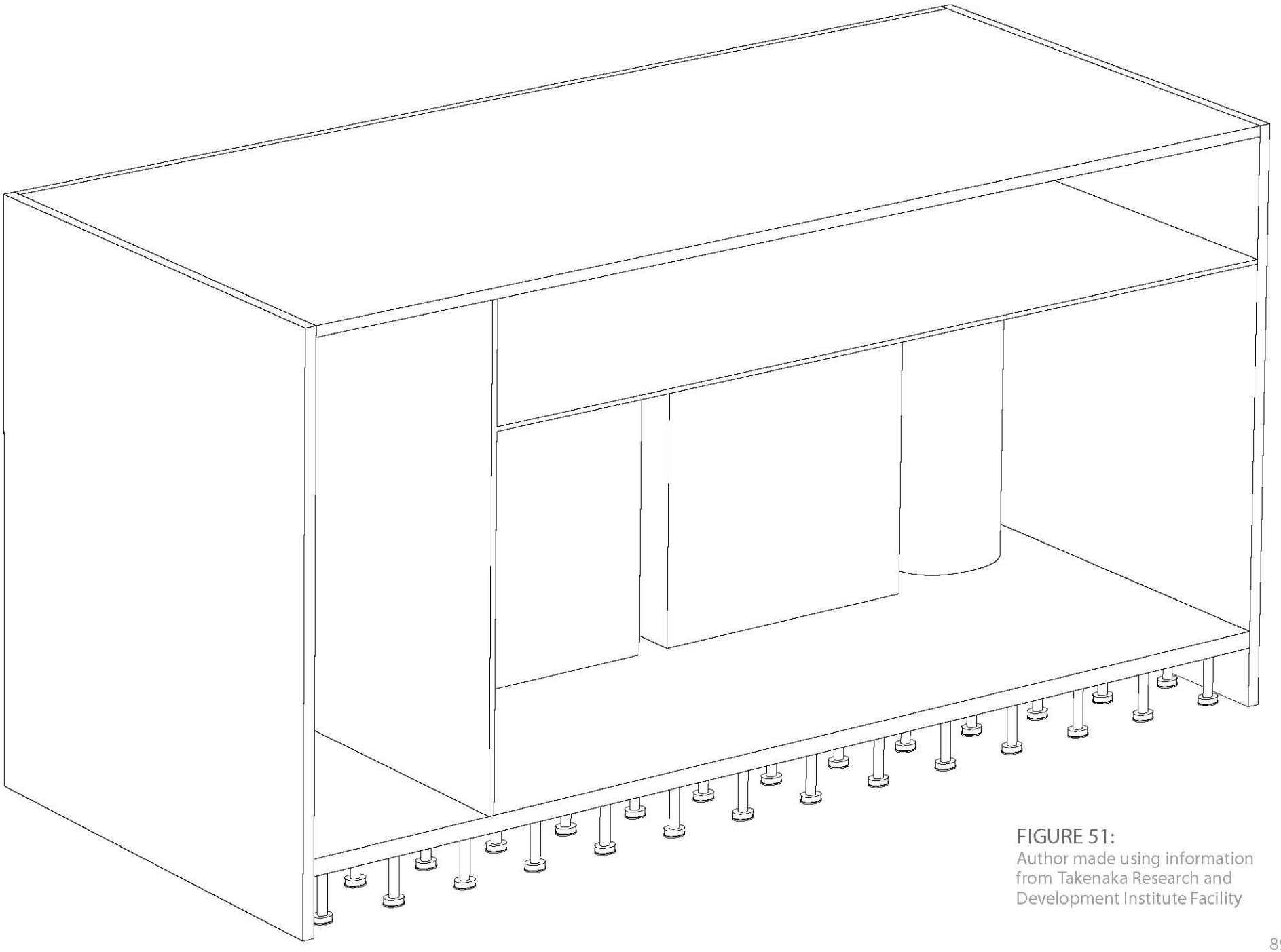
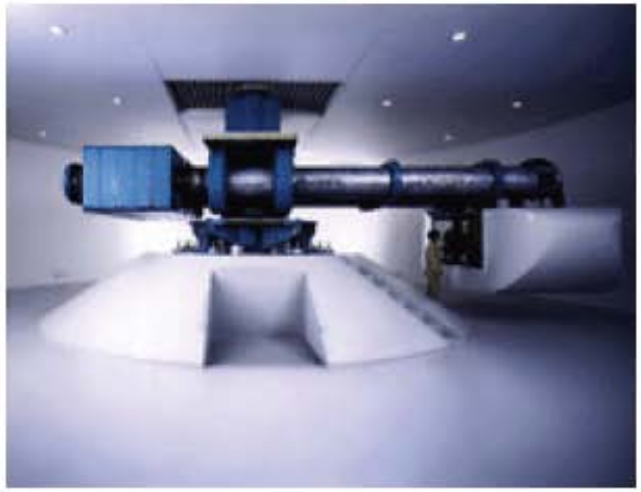


FIGURE 51:
Author made using information from Takenaka Research and Development Institute Facility

CENTRIFUGE FACILITY



One of the world's largest model laboratories of its kind, this facility helps predict structural and foundation deformation and failure through soil testing. It is particularly useful in the design of underground structures, building foundations and various kinds of infrastructures, and can simulate the soil pressure at depth up to 200 meters.[51]

Materials: Reinforced Concrete

Dimensions: 80' x 80' x 12'

Geometry Dependent: Yes

Base Imagery: Takenaka Research and Development Institute, Osaka, Japan and the University of Colorado, Boulder, Colorado

Risks: Exposure, Insecurity, Agricultural Productivity Loss, Lack of Adaptation, Extreme Weather, Ecological Footprint

Images From:

[51] TAKENAKA CORPORATION. "Takenaka Research and Development Institute Facility Overview." Accessed November 26, 2012. http://www.takenaka.co.jp/takenaka_e/company/r&d_e/rd_b.html

UNIVERSITY OF COLORADO CIVIL, ENVIRONMENTAL, AND ARCHITECTURAL ENGINEERING. "Geotechnical Centrifuge Laboratory." Accessed November 26, http://civil.colorado.edu/facilities-centers/facilities/geotechnical-centrifuge-laboratory/

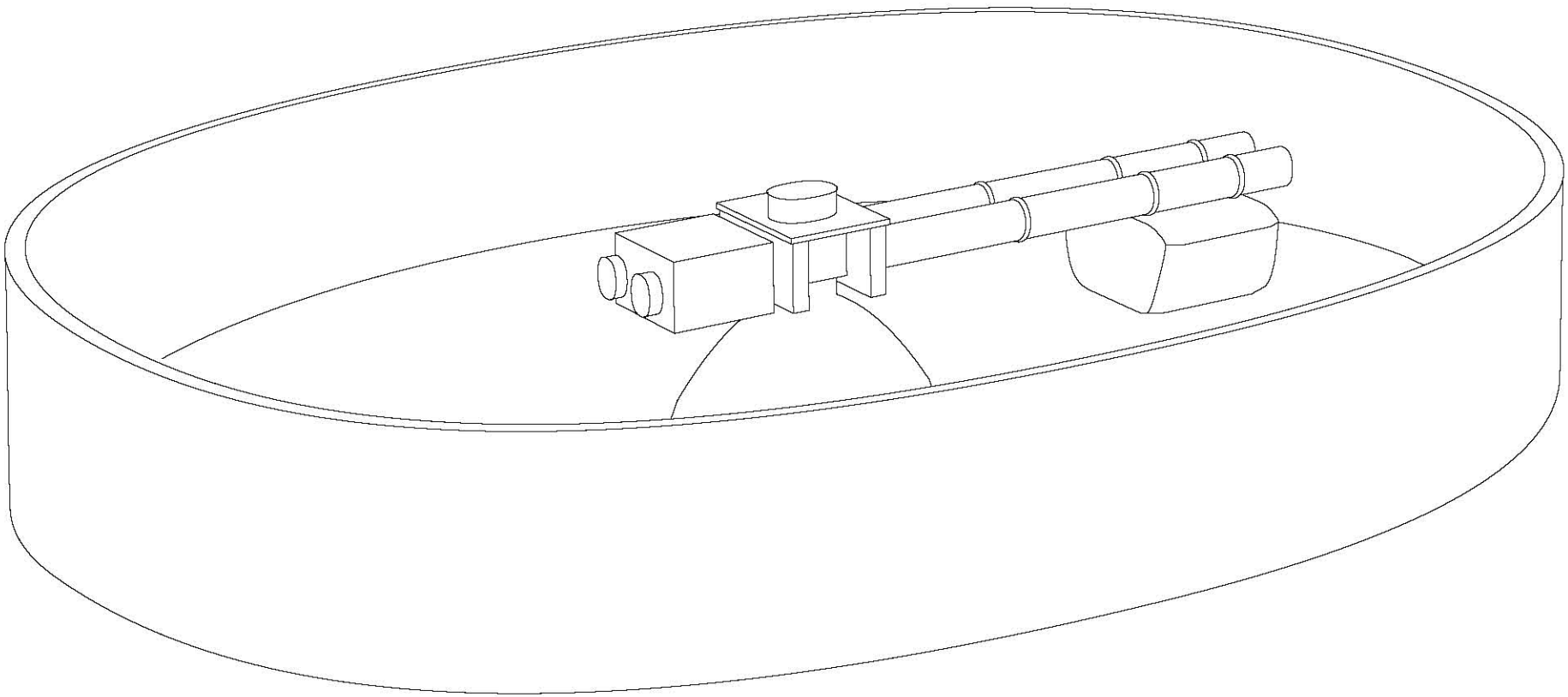
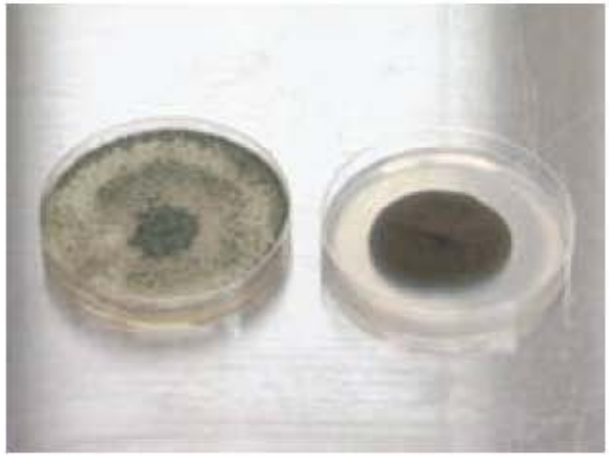


FIGURE 52:
Author made using information from Takenaka Research and Development Institute Facility and University of Colorado

BIOLOGICAL CLEAN ROOM LABORATORY



This facility is used to isolate and culture microorganisms that can clean up wastewater, pollutants, and microorganisms in various environments including food factories, pharmaceutical plants, and residences. It can also be used for medicinal purposes to test viruses and bacteria.[52]

Materials: Aluminum

Dimensions: 30' x 15'x 15'

Geometry Dependent: No

Base Imagery: Standard Clean Rooms

Risks: Extinct Species, Exposure, Insecurity, Food Deprivation, Terrorism, Communicable Disease, Lack of Coping Capabilities, Water Scarcity, Non-Communicable Disease, Endangered Species

Images From:

[52] TAKENAKA CORPORATION. "Takenaka Research and Development Institute Facility Overview." Accessed November 26, 2012. http://www.takenaka.co.jp/takenaka_e/company/r&d_e/rd_b.html

PANEL BUILT. "Modular Clean Rooms." Accessed November 26, 2012. http://www.panelbuilt.com/general/modular-clean-rooms.

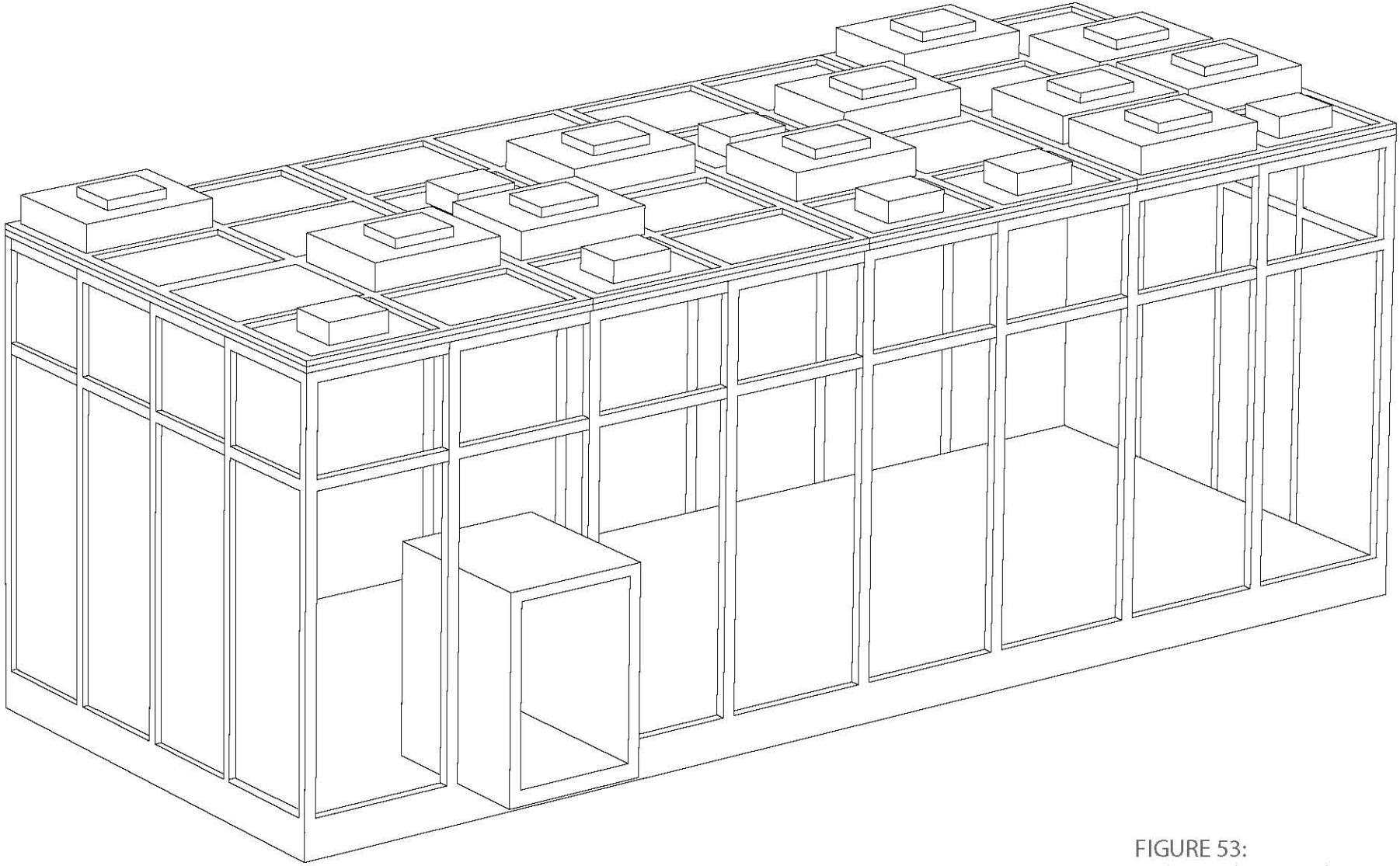


FIGURE 53:
Author made using information from Takenaka Research and Development Institute Facility

HORTICULTURE LABORATORY

This facility is used for testing mixing Aquaponics, Aeroponics, Nutrient Film Techniques (NFTs) and basic Flood & Drain hydroponic technology to create exciting new innovations in the field of indoor horticulture., as well as systems for green roofs and walls.[53]

Materials: Aluminum

Dimensions: Any

Geometry Dependent: No

Base Imagery: Takenaka Research and Development Institute, Osaka, Japan and EPCOT's The Land, Orlando, Florida

Risks: Extinct Species, Exposure, Agricultural Productivity Loss, Food Deprivation, Lack of Adaptation, Endangered Species, Extreme Weather, Fossil Fuel Dependency, Ecological Footprint

Images From:

[53] TAKENAKA CORPORATION. "Takenaka Research and Development Institute Facility Overview." Accessed November 26, 2012. http://www.takenaka.co.jp/takenaka_e/company/r&d_e/rd_b.html

ROSEBUD MAGAZINE. "Epcot's Hydroponic Wonderland: the Wonderful World of Disney Horticulture." Last modified 2011. http://www.rosebudmag.com/eco-trends/epcots-hydroponic-wonderland-wonderful-world-of-disney-horticulture.

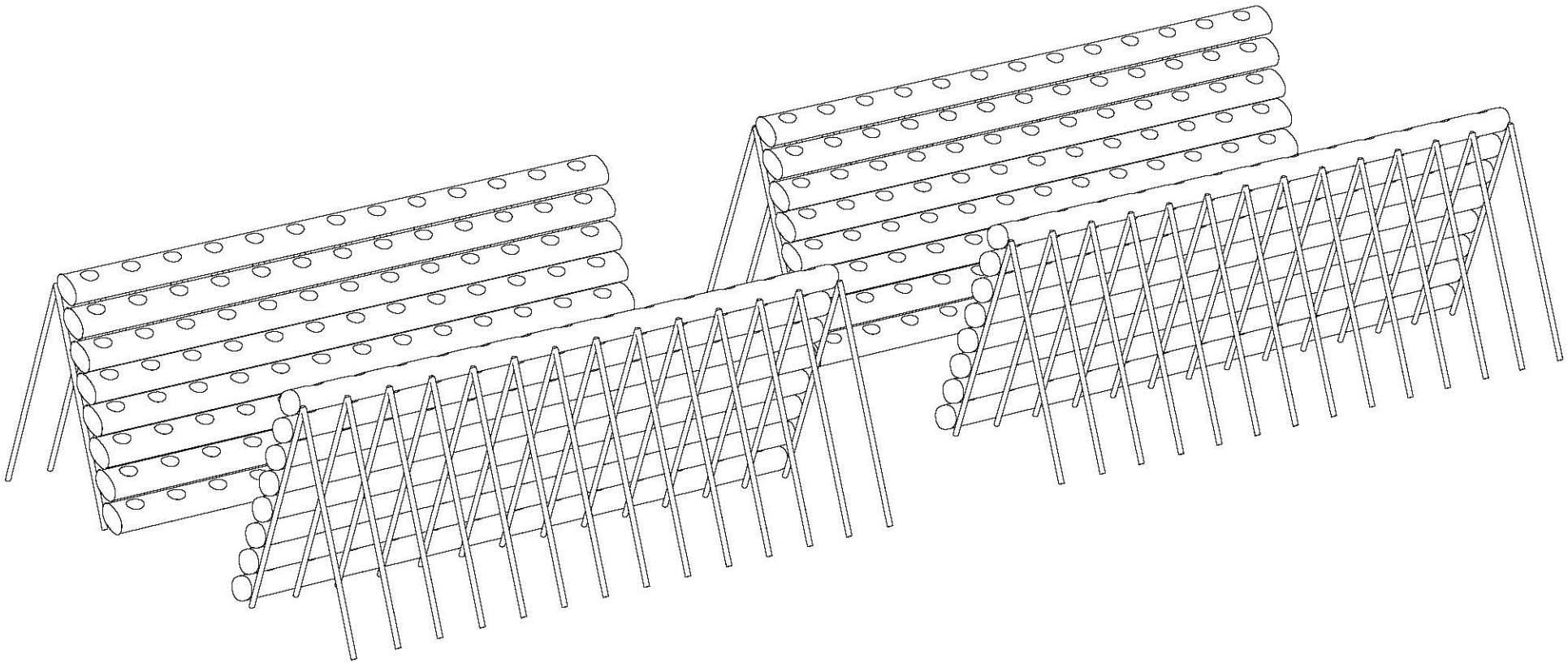


FIGURE 54:
Author made using information from Takenaka Research and Development Institute Facility and EPCOT hydrponics

INSECT CONTROL EXPERIMENTAL LABORATORY

Insect contamination can be a serious problem in the manufacturing of foods and pharmaceuticals. This facility is used for experiments with individual plants and insects provide optimized solutions according to type of industry and site environment.[54]

Materials: Aluminum

Dimensions: 30' x 15' x 15'

Geometry Dependent: No

Base Imagery: Takenaka Research and Development Institute, Osaka, Japan and Washington State University Greenhouses, Pullman, Washington

Risks: Extinct Species, Exposure, Insecurity, Agricultural Productivity Loss, Food Deprivation, Communicable Disease, Lack of Adaptation, Lack of Coping Capabilities, Endangered Species, Extreme Weather

Images From:

[54] TAKENAKA CORPORATION. "Takenaka Research and Development Institute Facility Overview." Accessed November 26, 2012. http://www.takenaka.co.jp/takenaka_e/company/r&d_e/rd_b.html

WASHINGTON STATE UNIVERSITY. "More About Our Greenhouses." Accessed November 26, 2012. http://entomology.wsu.edu/bill-snyder/facilities/greenhouses/.

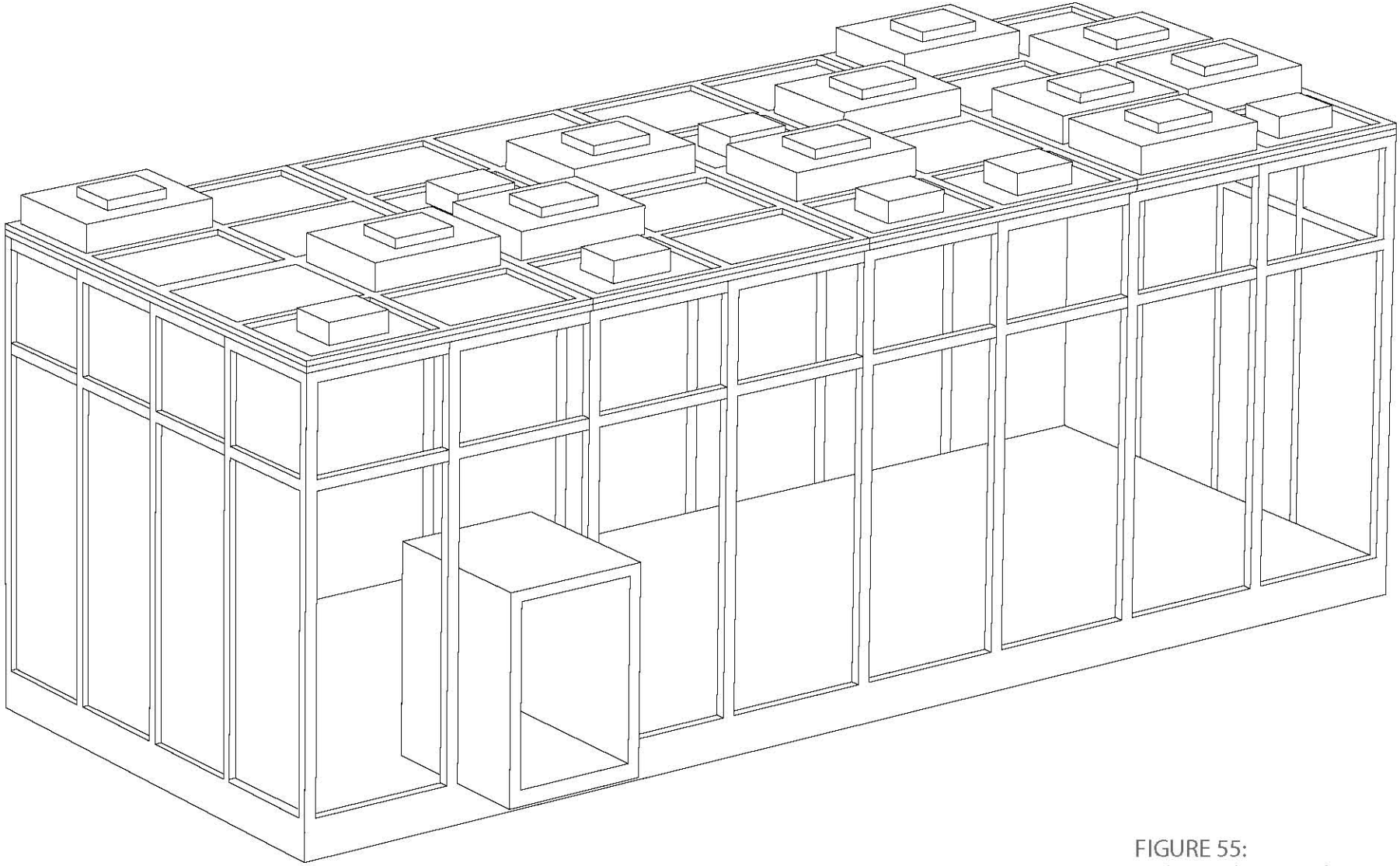


FIGURE 55:
Author made using information from Takenaka Research and Development Institute Facility

EARTHQUAKE TESTING ROOM

This facility is used to simulate earthquake movements. It can move up and down, side to side, backwards and forwards – simulating the motions of a real earthquake on full scale buildings and components.[55]

Materials: Steel, Reinforced Concrete

Dimensions: 100' x 80' x 45'

Geometry Dependent: Yes

Base Imagery: The National Science Foundation, Miki, Japan

Risks: Exposure, Insecurity, Vulnerability, Susceptibility, Lack of Adaptation, Lack of Coping Capabilities

Images From:

[55] WIRED MAGAZINE. "Fake Quake." Last Modified July 13, 2009. http://www.wired.com/wired-science/2009/07/quakesim/.

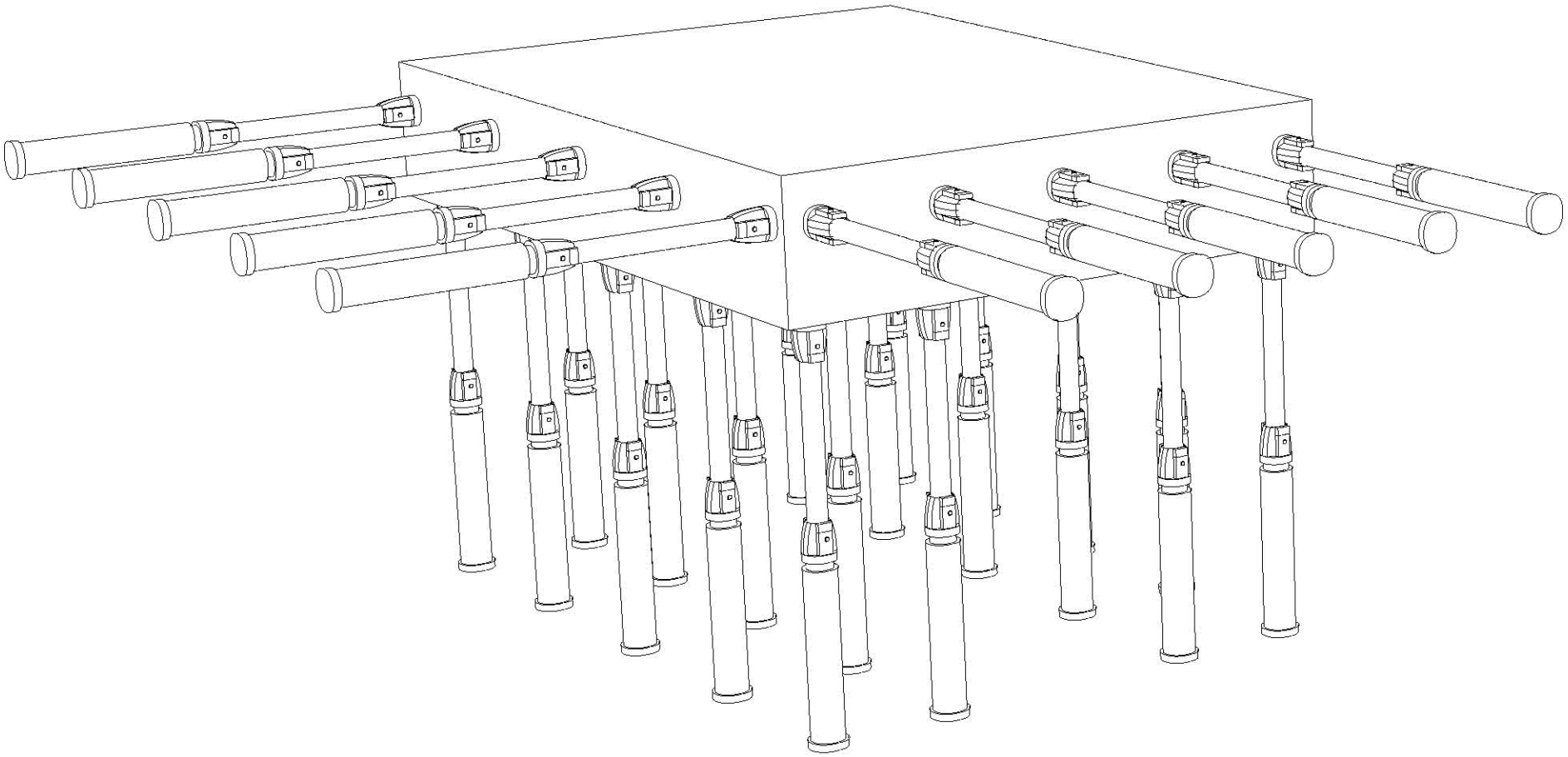


FIGURE 56:
Author made using information from the National Science Foundation

SOLAR TESTING ROOM

An "artificial sky" simulates natural long-wave radiation exchange can be used for measuring photovoltaic modules, thermal solar collectors and combinations of both technologies – known as PVT modules – for the first time in a sun simulator.[56]

Materials: Steel

Dimensions: 24' x 12' x 9'

Geometry Dependent: No

Base Imagery: TUV Rheinland, Cologne, Germany

Risks: Exposure, Insecurity, Agricultural Productivity Loss, Food Deprivation, Lack of Adaptation, Water Scarcity, Extreme Weather, Ecological Footprint, Fossil Fuel Dependency

Images From:

[56] SOLAR SERVER. "Sun Simulator." Last Modified June 1, 2010. http://www.solarserver.com/solar-magazine/solar-news/current/2011/kw22/pse-ag-constructs-combined-sun-simulator-for-tuev-rheinland.html.

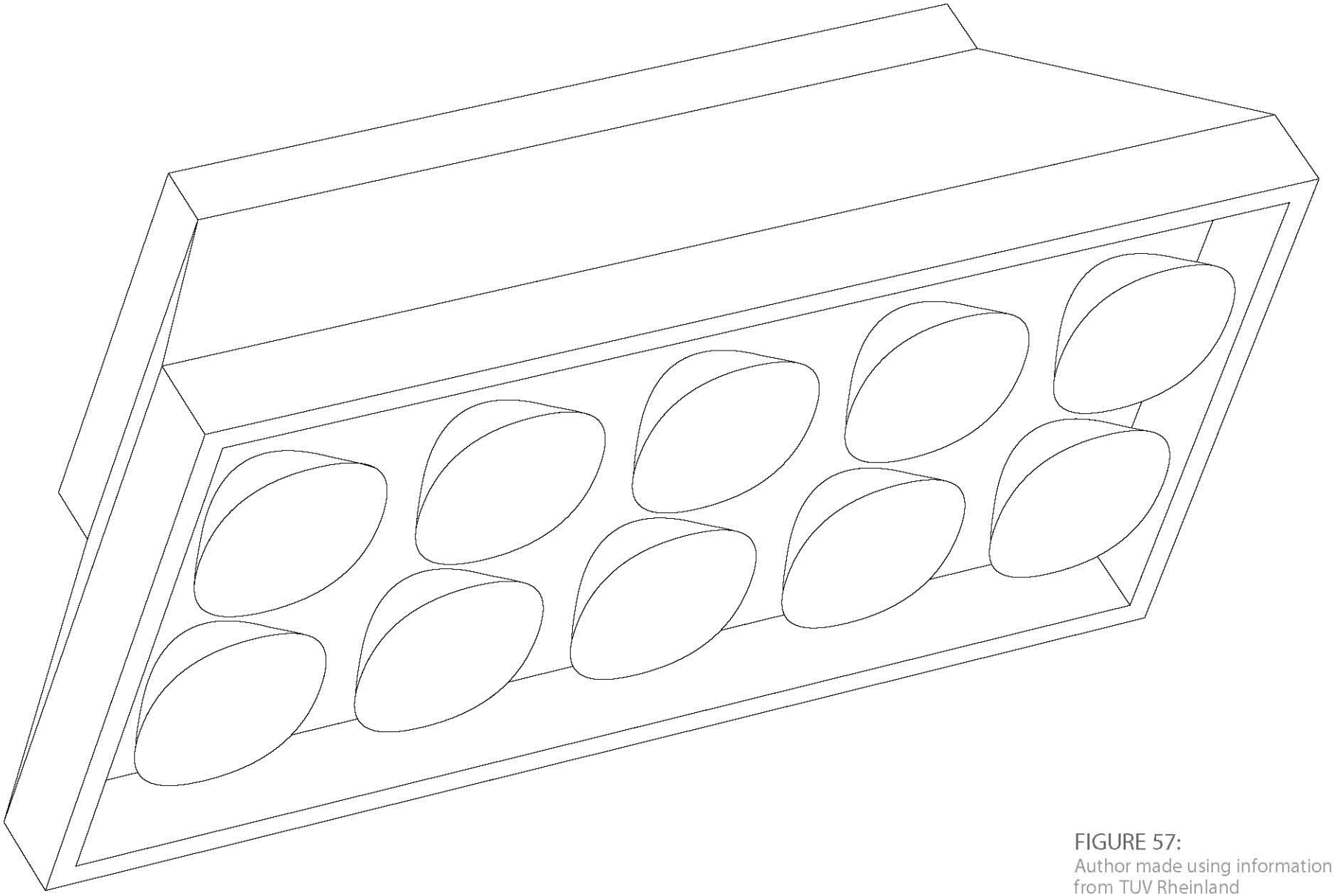


FIGURE 57:
Author made using information
from TUV Rheinland

EXTREME TEMPERATURE TEST CHAMBER

The chamber, the largest of its kind, is capable of holding a tractor trailer combination. The chamber has both temperature and humidity controls, as well as a solar array and a wind simulator. The chamber can provide temperatures from -25°C to 55°C. The humidity is capable of reaching 70% RH at 40°C with the solar lights running. The solar lights cover an area 8'6" x 10", and can raise and lower with the chamber. The wind simulation is capable of producing wind speeds of up to 35 MPH across the entire front section of a HDDV truck, from a height of 6' up to 10'.[57]

Materials: Steel, Aluminum

Dimensions: 75' x 23' x 22'

Geometry Dependent: No

Base Imagery: Texas A&M Transportation Insitute, College Station, Texas and Mercedes Benz, Stuttgart, Germany

Risks: Exposure, Insecurity, Agricultural Productivity Loss, Food Deprivation, Vulnerability, Susceptibility, Lack of Adaptation, Extreme Weather, Endangered Species, Extinct Species, Non-Communicable Disease

Images From:

[57] TEXAS A&M TRANSPORTATION INSTITUTE. "Testing Equipment." Accessed November 26, 2012. http://tti.tamu.edu/group/airquality/equipment/.
MOTOR AUTHORITY. "Mercedes-Benz's Wind Tunnel Provides Weather on Demand." Last Modified July 18, 2011. http://www.motorauthority.com/news/1063306_mercedes-benz-wind-tunnel-provides-weather-on-demand.

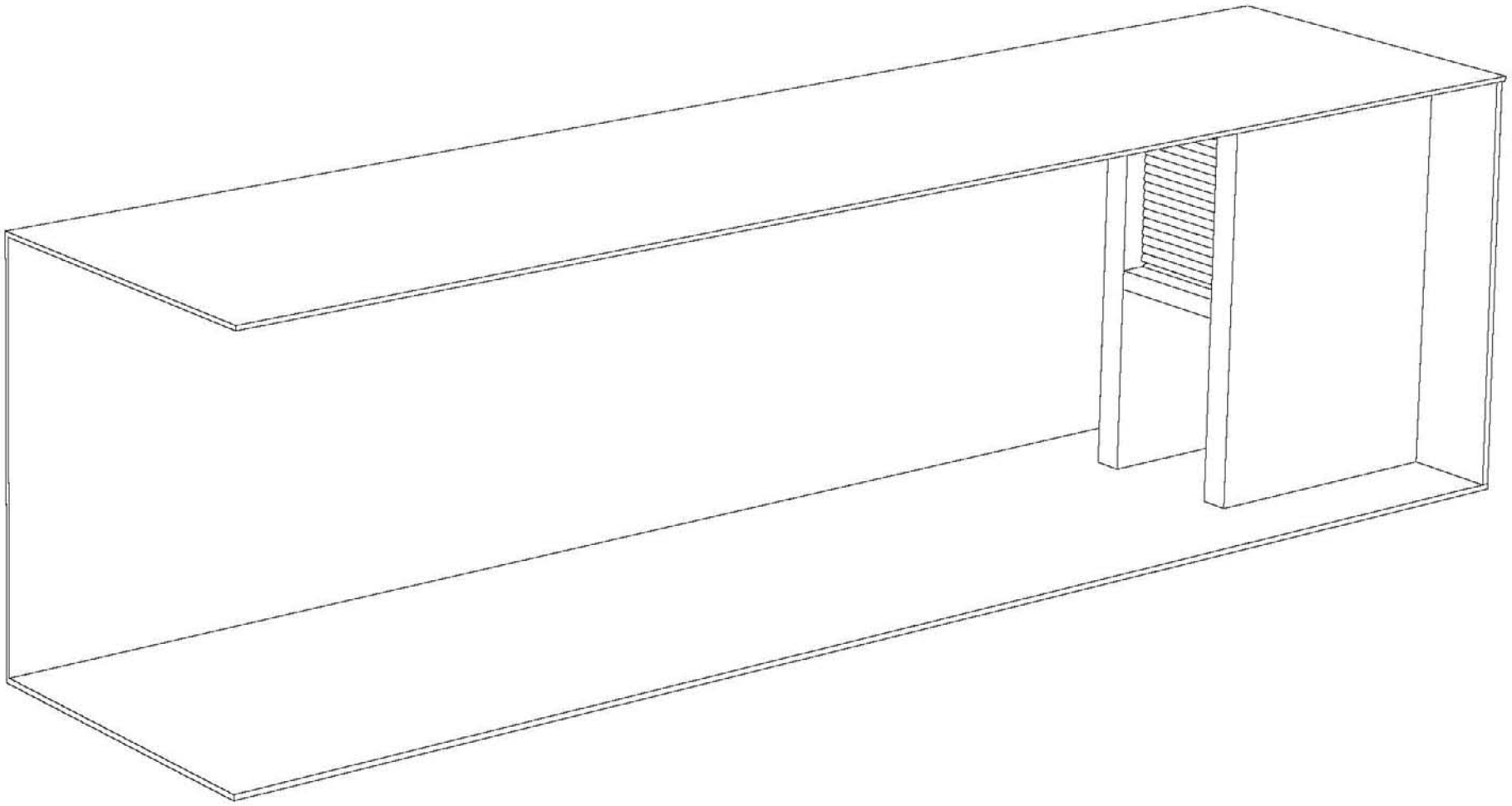
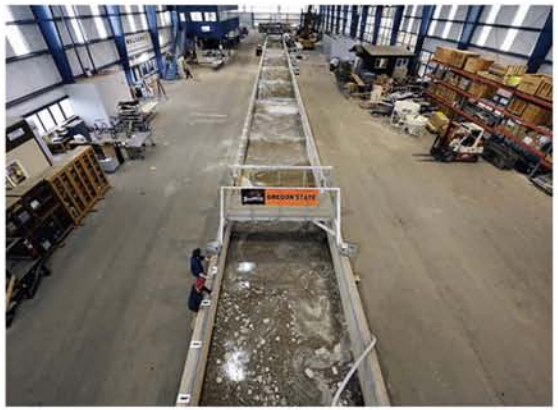


FIGURE 58:
Author made using information from Texas A&M and Mercedes-Benz

TSUNAMI AND FLOODING TESTING FACILITY



The 342-foot-long tank, 15-foot-deep flume is filled with 300,000 gallons of fresh water. The bottom of the tank is flat, then slopes up and ends in a plateau. The profile, varied by experiment, simulates the effect of a beach, making waves break when they hit shallower depths. The machine allows scientists to study regular waves, which consist of a series of troughs and crests, and tsunamis, which are generated as solitary waves.[58]

Materials: Reinforced Concrete

Dimensions: 324' x 17' x 35'

Geometry Dependent: Yes

Base Imagery: Oregon State University, Corvallis, Oregon

Risks: Sea Level Rise, Exposure, Insecurity, Susceptibility, Lack of Adaptation, Extreme Weather, Ecological Footprint, Endangered Species, Extinct Species

Images From:

[58]POPULAR MECHANICS. "How a Hurricane Wave Maker Works." Last Modified March 24, 2010. http://www.popularmechanics.com/science/environment/natural-disasters/4350147.

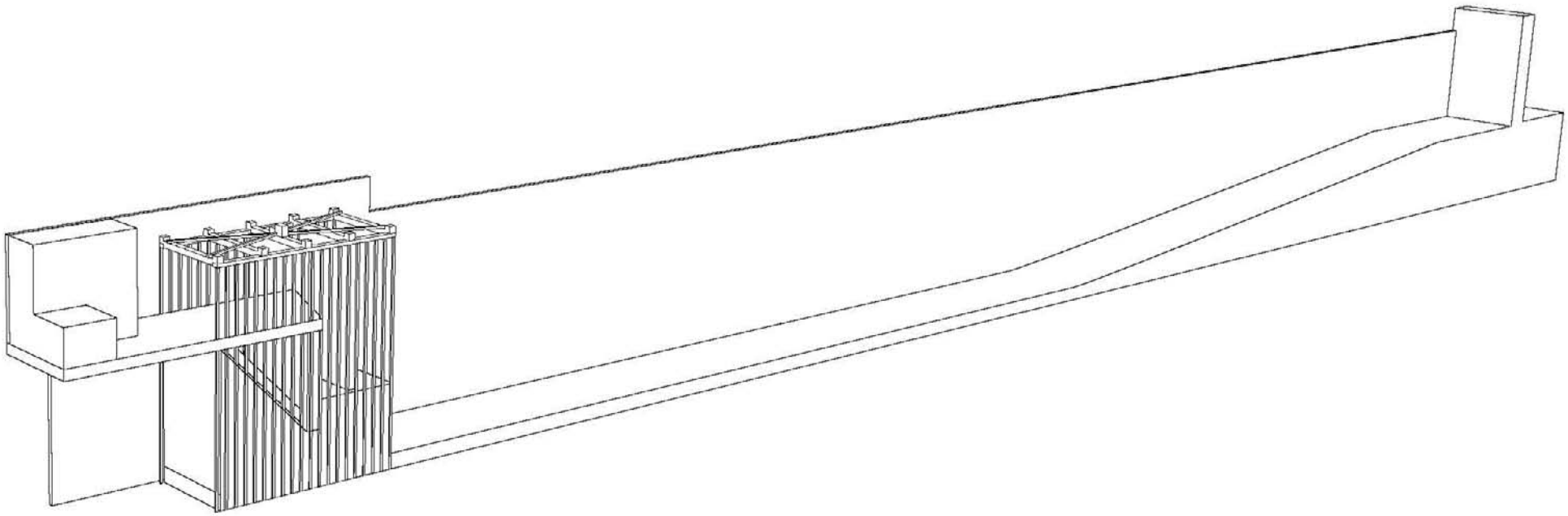


FIGURE 59:
Author made using information
from Oregon State University

MISSILE IMPACT TESTING

This facility tests fatigue and use over time. The 2 meter diameter experiment tank can house bulky target and diagnostic systems, such as heating/cooling hardware or optics/X-ray positioning stages, allowing simultaneous complex measurements to be performed.[59]

Materials: Steel, Titanium

Dimensions: 43'x 7'x 7'

Geometry Dependent: Yes

Base Imagery: Imperial College London, Kensington Campus, London, England

Risks: Terrorism, Insecurity, Lack of Coping Capabilities, Extreme Weather, Fossil Fuel Dependency, Exposure

Images From:

[59] IMPERIAL COLLEGE LONDON. "Experimental Facilities." Accessed November 26, 2012. http://www3.imperial.ac.uk/shockphysics/facilities.

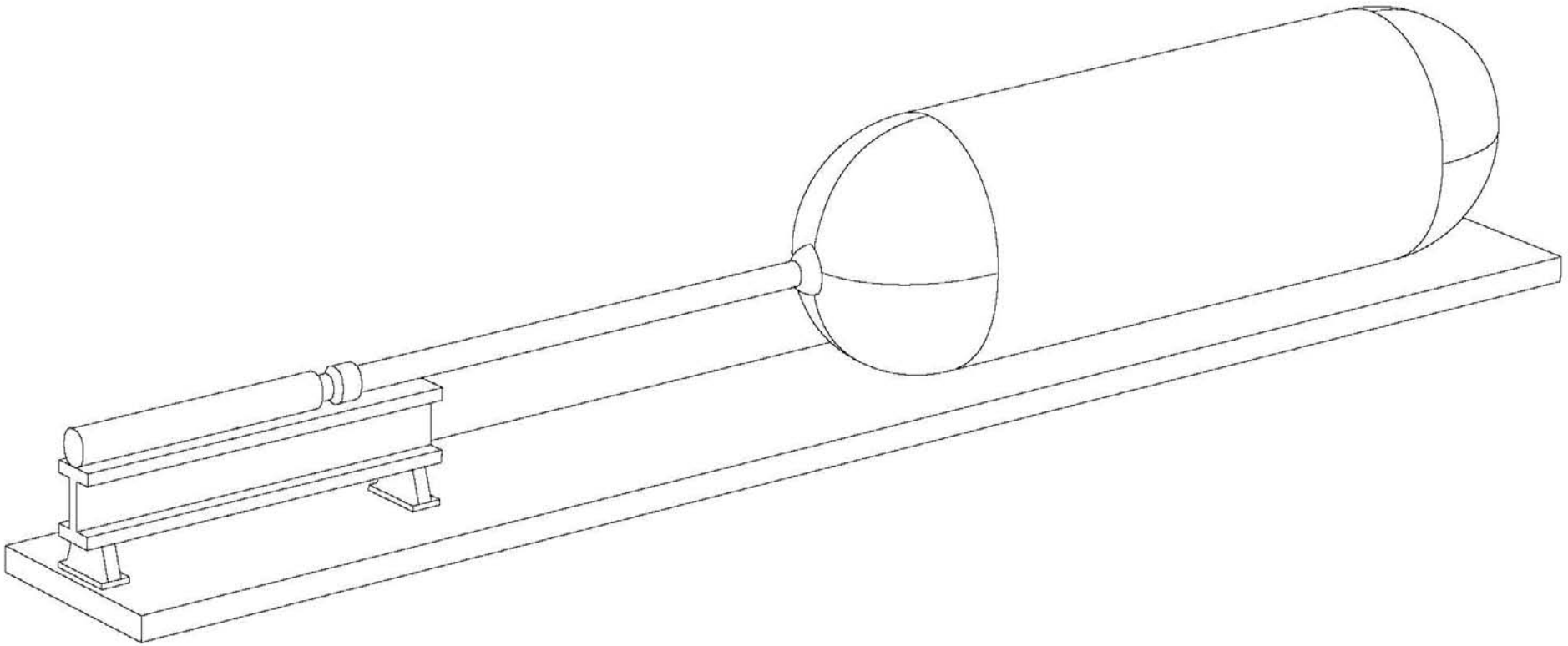


FIGURE 60:
Author made using information
from Imperial College London

THE RULES OF THE GAME

Using a matrix can help to understand architecture's capacity in handling risk. Throughout a project's lifespan, its ability to handle risk can vary from stage to stage. In order to understand how buildings operate in terms of risk, case studies were chosen that address risk on a global scale and compared through their construction, exterior environment, interior environment, assembly practices, and programmatic use.

The lessons learned from these case studies will be used in designing the building testing facility to ensure that each testing lab either blocks or bypasses risks rather than producing or ignoring them. The building itself will also have to adhere to these standards for the given site once it is chosen.

KEY

	CONSTRUCTION	EXTERIOR ENVIRONMENT	INTERIOR ENVIRONMENT	MEANS OF ASSEMBLY	PROGRAM
SVALBARD GLOBAL SEED VAULT					
WALLOON BRANCH OF REPRODUCTIVE FORESTRY MATERIAL					
ECO ARK FOR CLIMATE CHANGE REFUGEES					
ARK HOTEL FOR CLIMATE CHANGE REFUGEES					
PHYSALIA MOBILE WATER PURIFICATION LAB					

FIGURE 61:

SVALBARD GLOBAL SEED BANK

A seed storage bank in the Arctic for storing a global reserve. The building is bomb proof and uses thermal properties to keep the building self sustaining for up to three days. The project also uses its isolation to its advantage in preventing attacks.[60]

Author made using information from:

[60]BUILD. "The Architecture of Seed Banks." Last Modified March 1, 2008. http://blog.buildllc.com/2008/03/the-architecture-of-seed-banks/

SVALBARD GLOBAL SEED VAULT

	PRODUCE RISK	BLOCK RISK	IGNORE RISK	BYPASS RISK	HOUSE RISK
ECOLOGICAL FOOTPRINT					
FOSSIL FUEL DEPENDENCY					
EXTREME WEATHER					
ENDANGERED SPECIES					
NON-COMMUNICABLE DISEASE					

	PRODUCE RISK	BLOCK RISK	IGNORE RISK	BYPASS RISK	HOUSE RISK
WATER SCARCITY					
LACK OF COPING CAPABILITIES					
LACK OF ADAPTIVE CAPACITIES					
SUSCEPTIBILITY					
VULNERABILITY					

	PRODUCE RISK	BLOCK RISK	IGNORE RISK	BYPASS RISK	HOUSE RISK
COMMUNICABLE DISEASE					
TERRORISM					
FOOD DEPRIVATION					
AGRICULTURAL PRODUCTIVITY LOSS					
POLITICAL/ ECONOMICAL					

FIGURE 63:

SEED CATHEDRAL

Designed by Heatherwick Studio, the seed cathedral displays seeds in glass tubes, making the seed useless for growing. The aim is for spectacle rather than for preservation.[62]

Author made using information from:

[62]HEATHERWICK STUDIO. "UK Pavilion: Shanghai Expo 2010." Accessed September 29, 2012. http://www.heatherwick.com/uk-pavilion/

SEED CATHEDRAL

	PRODUCE RISK	BLOCK RISK	IGNORE RISK	BYPASS RISK	HOUSE RISK
ECOLOGICAL FOOTPRINT					
FOSSIL FUEL DEPENDENCY					
EXTREME WEATHER					
ENDANGERED SPECIES					
NON-COMMUNICABLE DISEASE					

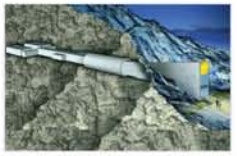
	PRODUCE RISK	BLOCK RISK	IGNORE RISK	BYPASS RISK	HOUSE RISK
INSECURITY					
POPULATION GROWTH					
EXPOSURE					
SEA LEVEL RISE					
EXTINCT SPECIES					

FIGURE 62:

WALLOON BRANCH OF REPRODUCTION FORESTRY MATERIAL

Designed by Samyn and Partners, the Walloon Branch is a seed storage bank in the Belguim for storing a global reserve. The building uses thermal properties to keep the building self sustaining. The project also uses wood from seeds from its reserve to make the building .[61]

Author made using information from:

[61]BUILD. "The Architecture of Seed Banks." Last Modified March 1, 2008. http://blog.buildllc.com/2008/03/the-architecture-of-seed-banks/

WALLOON BRANCH OF REPRODUCTIVE FORESTRY

	PRODUCE RISK	BLOCK RISK	IGNORE RISK	BYPASS RISK	HOUSE RISK
ECOLOGICAL FOOTPRINT					
FOSSIL FUEL DEPENDENCY					
EXTREME WEATHER					
ENDANGERED SPECIES					
NON-COMMUNICABLE DISEASE					

	PRODUCE RISK	BLOCK RISK	IGNORE RISK	BYPASS RISK	HOUSE RISK
WATER SCARCITY					
LACK OF COPING CAPABILITIES					
LACK OF ADAPTIVE CAPACITIES					
SUSCEPTIBILITY					
VULNERABILITY					

	PRODUCE RISK	BLOCK RISK	IGNORE RISK	BYPASS RISK	HOUSE RISK
INSECURITY					
POPULATION GROWTH					
EXPOSURE					
SEA LEVEL RISE					
EXTINCT SPECIES					

	PRODUCE RISK	BLOCK RISK	IGNORE RISK	BYPASS RISK	HOUSE RISK
COMMUNICABLE DISEASE					
TERRORISM					
FOOD DEPRIVATION					
AGRICULTURAL PRODUCTIVITY LOSS					
POLITICAL/ ECONOMICAL					

	PRODUCE RISK	BLOCK RISK	IGNORE RISK	BYPASS RISK	HOUSE RISK
WATER SCARCITY					
LACK OF COPING CAPABILITIES					
LACK OF ADAPTIVE CAPACITIES					
SUSCEPTIBILITY					
VULNERABILITY					

	PRODUCE RISK	BLOCK RISK	IGNORE RISK	BYPASS RISK	HOUSE RISK
COMMUNICABLE DISEASE					
TERRORISM					
FOOD DEPRIVATION					
AGRICULTURAL PRODUCTIVITY LOSS					
POLITICAL/ ECONOMICAL					

	PRODUCE RISK	BLOCK RISK	IGNORE RISK	BYPASS RISK	HOUSE RISK
INSECURITY					
POPULATION GROWTH					
EXPOSURE					
SEA LEVEL RISE					
EXTINCT SPECIES					

FIGURE 64:

LILYPAD ECO ARK

Designed by Vincent Callebait Architctures, Eco Ark for would be used for climate change refugees. It would travel the world to where it is most needed. Housing, entertainment, and ecology would all be contained in the vessel.[63]

Author made using information from:

[63]VINCENT CALLEBAUT ARCHITECTURES. "Lilypad." 2008. Accessed September 30, 2012. http://vincent.callebaut.org/page1-img-lilypad.html

LILYPAD ECO ARK

	PRODUCE RISK	BLOCK RISK	IGNORE RISK	BYPASS RISK	HOUSE RISK
ECOLOGICAL FOOTPRINT					
FOSSIL FUEL DEPENDENCY					
EXTREME WEATHER					
ENDANGERED SPECIES					
NON-COMMUNICABLE DISEASE					

	PRODUCE RISK	BLOCK RISK	IGNORE RISK	BYPASS RISK	HOUSE RISK
WATER SCARCITY					
LACK OF COPING CAPABILITIES					
LACK OF ADAPTIVE CAPACITIES					
SUSCEPTIBILITY					
VULNERABILITY					

	PRODUCE RISK	BLOCK RISK	IGNORE RISK	BYPASS RISK	HOUSE RISK
COMMUNICABLE DISEASE					
TERRORISM					
FOOD DEPRIVATION					
AGRICULTURAL PRODUCTIVITY LOSS					
POLITICAL/ ECONOMICAL					

	PRODUCE RISK	BLOCK RISK	IGNORE RISK	BYPASS RISK	HOUSE RISK
INSECURITY					
POPULATION GROWTH					
EXPOSURE					
SEA LEVEL RISE					
EXTINCT SPECIES					

FIGURE 65:

ARK HOTEL

Designed by Remistudio, Ark Hotel is an ark built for climate change refugees. It can function both on land and in water and would travel where it's needed.[64]

Author made using information from:

[64]REMISTUDIO. "Ark." Accessed September 30, 2012. http://remistudio.ru/en/pages/52.htm.

ARK HOTEL

	PRODUCE RISK	BLOCK RISK	IGNORE RISK	BYPASS RISK	HOUSE RISK
ECOLOGICAL FOOTPRINT					
FOSSIL FUEL DEPENDENCY					
EXTREME WEATHER					
ENDANGERED SPECIES					
NON-COMMUNICABLE DISEASE					

	PRODUCE RISK	BLOCK RISK	IGNORE RISK	BYPASS RISK	HOUSE RISK
WATER SCARCITY					
LACK OF COPING CAPABILITIES					
LACK OF ADAPTIVE CAPACITIES					
SUSCEPTIBILITY					
VULNERABILITY					

	PRODUCE RISK	BLOCK RISK	IGNORE RISK	BYPASS RISK	HOUSE RISK
COMMUNICABLE DISEASE					
TERRORISM					
FOOD DEPRIVATION					
AGRICULTURAL PRODUCTIVITY LOSS					
POLITICAL/ ECONOMICAL					

	PRODUCE RISK	BLOCK RISK	IGNORE RISK	BYPASS RISK	HOUSE RISK
INSECURITY					
POPULATION GROWTH					
EXPOSURE					
SEA LEVEL RISE					
EXTINCT SPECIES					

FIGURE 66:

PHYSALIA

Designed by Vincent Callebait Architctures, Physalia is a mobile water purification lab the would travel European waterways and treat the water as it travelled.[65]

Author made using information from:

[65]VINCENT CALLEBAUT ARCHITECTURES. "Physalia." 2010. Accessed September 30, 2012. http://vincent.callebaut.org/page1-img-physalia.html

PHYSALIA WATER LAB

	PRODUCE RISK	BLOCK RISK	IGNORE RISK	BYPASS RISK	HOUSE RISK
ECOLOGICAL FOOTPRINT					
FOSSIL FUEL DEPENDENCY					
EXTREME WEATHER					
ENDANGERED SPECIES					
NON-COMMUNICABLE DISEASE					

	PRODUCE RISK	BLOCK RISK	IGNORE RISK	BYPASS RISK	HOUSE RISK
WATER SCARCITY					
LACK OF COPING CAPABILITIES					
LACK OF ADAPTIVE CAPACITIES					
SUSCEPTIBILITY					
VULNERABILITY					

	PRODUCE RISK	BLOCK RISK	IGNORE RISK	BYPASS RISK	HOUSE RISK
COMMUNICABLE DISEASE					
TERRORISM					
FOOD DEPRIVATION					
AGRICULTURAL PRODUCTIVITY LOSS					
POLITICAL/ ECONOMICAL					

	PRODUCE RISK	BLOCK RISK	IGNORE RISK	BYPASS RISK	HOUSE RISK
INSECURITY					
POPULATION GROWTH					
EXPOSURE					
SEA LEVEL RISE					
EXTINCT SPECIES					

PLAYING THE GAME

With all the pieces of the game in order, the final step of actually implementing the game will be carried out through design. **The ultimate goal of the project is to create a "game stadium" where all the risk factors and building methods can be tested one by one or all at once on real buildings and building components.** A stadium of this nature will allow the United Nations to test its structures on a country by country basis in order to aid the nations most at threat before a risk becomes realized, while still keeping the facility itself safe from harm. In this way, the project will live up to Fuller's own approach of being comprehensive, anticipatory, a design strategy, and a science-based methodology that works to benefit all of humanity.

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An inside look into wind tunnel technology.

BUCKMINSTER FULLER INSTITUTE. "The World Game." Accessed September 30, 2012. http://bfi.org/about-bucky/buckys-big-ideas/world-game

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